Vector-Borne Diseases in California

2001 Annual Report

Vector-Borne Disease Section
California Department of Health Services
August 2002

2001

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

DISEASE INVESTIGATIONS AND SURVEILLANCE BRANCH

DIVISION OF COMMUNICABLE DISEASE CONTROL

CALIFORNIA DEPARTMENT OF HEALTH SERVICES

Gray Davis
Governor
State of California

Grantland Johnson, Secretary
Health and Human Services Agency

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Department of Health Services

2001

ANNUAL REPORT

VECTOR-BORNE DISEASE SECTION

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This Annual Report is
dedicated in memory of

Richard F. Peters
1915-2001

Chief, Bureau of Vector Control
(currently Vector-Borne Disease Section)
California Department of Health Services
1951-1978

A Note From The Chief

I am pleased to submit to you the 2001 Annual Report for the Vector-Borne Disease Section (VBDS) of the California Department of Health Services. We had a very active year in 2001, conducting surveillance, prevention, and control of existing and emerging vector-borne diseases and vectors in California. In June, we responded quickly to assist local agencies subsequent to the detection of *Aedes albopictus*, the Asian tiger mosquito, in Los Angeles County. Staff consulted with local, state, and federal agencies to reduce the public health threat of this exotic mosquito, and keep track of surveillance and control activities throughout the state.

West Nile virus spread into the midwestern and southeastern United States in 2001, and was detected in 27 states. To enhance our ability to detect West Nile virus if introduced into California, we streamlined the dead bird surveillance program and expanded other components of the mosquito-borne virus surveillance system in collaboration with our state and local partners.

Our biologists investigated an outbreak of relapsing fever on the eastern side of the Sierra Nevada, and conducted surveillance for arenavirus in woodrats and other rodents in the foothills. Numerous plague surveys were conducted at recreational sites in California, and plague control was initiated at two sites where evidence of plague epizootics presented a risk of human exposure. We expanded our laboratory capabilities to support enhanced surveillance for *Borrelia burgdorferi*, the causative agent of Lyme disease.

Because of an increase in VBDS staffing over the past several years, we reorganized in 2001 and our group now has three, rather than two, regions. Stan Husted, M.P.H., was promoted to serve as the Supervising Public Health Biologist for the newly created Coastal Region. Ken Linthicum, Ph.D., joined VBDS in June as the Supervisor for the Southern Region, replacing Chuck Myers, who retired in 2000 after 40 years of service. This reorganization has enhanced our ability to coordinate staff activities and work even more effectively with collaborating local and state agencies.

Lucia Hui, M.S., Senior Public Health Biologist, was awarded the Department's Superior Accomplishment Award in 2001. For the last 31 years, Lucia has provided outstanding service to many local and state agencies, and has enhanced our understanding of vector-borne diseases in the coastal regions of California through her surveillance and research efforts.

Many of you are our collaborators and colleagues and I hope that you find the information contained in this annual report to be of value as we collectively strive to promote and protect the health of all Californians.

Respectfully,

Vicki L. Kramer, Ph.D.

Introduction

The mission of the Vector-Borne Disease Section (VBDS), California Department of Health Services (DHS), is to protect the health and well-being of Californians from insect and animal transmitted diseases and injurious pests. VBDS provides leadership, information, and consultation on vector-borne diseases to the general public and agencies engaged in vector control activities.

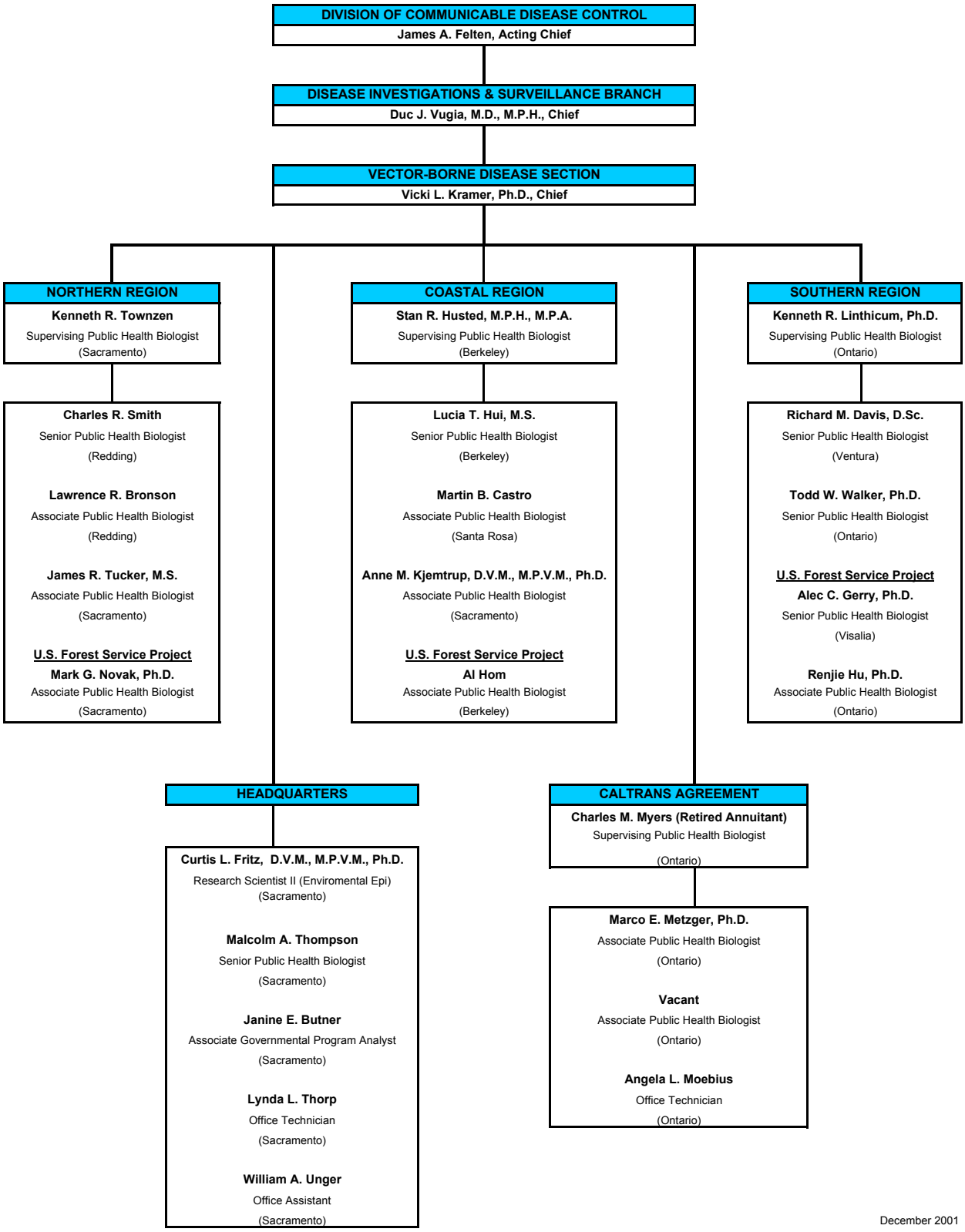
VBDS staff, located in seven regional offices and headquartered in Sacramento, provide the following services:

- Develop and implement statewide vector-borne disease surveillance, prevention, and control programs
- Design and conduct scientific investigations to further knowledge of vector-borne diseases in California
- Coordinate preparedness activities for detection and response to introduced vectors and vector-borne diseases, such as West Nile virus
- Conduct emergency vector control when disease outbreaks occur
- Administer public health exemptions where applicable under the Endangered Species Act in disease outbreaks
- Advise local agencies on difficult public health issues related to vector-borne diseases
- Oversee local vector control agency activities through a Cooperative Agreement
- Oversee the Vector Control Technician Certification and Continuing Education programs
- Provide information, training, and educational materials to governmental agencies and the public
- Provide assistance in coordinating issues related to the management of Africanized honey bees and red imported fire ants
- Advise local governmental agencies, schools, and the public on head lice management
- Maintain the San Francisco Bay Area U.S. Army Corps of Engineers general permit, which allows local vector control agencies to conduct abatement activities
- Oversee Special Local Need permits on restricted use of public health pesticides

This report summarizes surveillance and control activities for plague, hantavirus pulmonary syndrome, and mosquito- and tick-borne diseases in 2001. The Asian tiger mosquito infestations and the VBDS head lice programs are described. Activities conducted in the National Forests of California to protect United States Forest Service (USFS) personnel and visitors from vector-borne diseases are included in this report; USFS provides support for these activities through a cost-share agreement. Results from a special project with the California Department of Transportation to examine vector production in stormwater treatment devices are described. VBDS oversees the Vector Control Technician Certification Program; data summarizing the number of exams administered by VBDS and the number of vector control technicians in each certification category are provided. As education and training are important components of a vector-borne disease prevention program, a summary of the many presentations and reports originating from VBDS staff is included. Many of the state and local agencies with which VBDS collaborated in 2001 are listed in the Acknowledgments section.

Authorizing statutes include: HSC 116108-116120; HSC 116102, et. seq.; HSC 116180; Gov. Code 12582

Personnel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December 2001

Rodent-borne Virus Surveillance

Hantavirus

Human case surveillance
No cases of hantavirus pulmonary syndrome were identified in California residents during 2001.

Rodent surveillance
Surveillance for hantavirus in rodents was conducted in 13 California counties during 2001. A total of 1347 rodents were collected and serologically tested by the California Department of Health Services (DHS) Viral and Rickettsial Disease Laboratory, representing at least 21 species from nine genera (Table 1).[1] At least one seroreactive rodent was detected in eight counties. Of 1052 *Peromyscus* spp. collected, 49 (4.7 %) had serologic evidence of infection with Sin Nombre virus (SNV). Seroprevalence was highest in *Peromyscus maniculatus* at 11.5 percent. Active surveillance since 1993 and retrospective analysis of rodent specimens captured since 1975 have identified serologic evidence of SNV infection in 582 (10.6 %) of 5478 *P. maniculatus* collected and tested. At least one seroreactive *P. maniculatus* specimen has been identified in 43 of 53 counties sampled (Table 2). *Reithrodontomys megalotis* and *Microtus californicus* specimens have demonstrated evidence of infection with Sin Nombre-like hantaviruses (El Moro Canyon and Isla Vista, respectively), but these strain variants have not been shown to be pathogenic to humans. Seroreactivity has been occasionally identified in *Neotoma*, *Chaetodipus*, and *Spermophilus* rodents in California and elsewhere; however, it is believed that these species are incidentally infected with SNV and are not competent reservoirs or vectors.

Vector-Borne Disease Section (VBDS) completed the first year of a multi-year study to describe the dynamics of rodents and hantavirus infection in northern California. In September 2000, VBDS initiated routine rodent collection and serologic testing at a U.S. Forest Service fire station in Plumas National Forest, Lassen County. Seven lines of 25 traps each were established, encompassing four habitats: altered oak woodland, dry hillside, riparian, and in and around buildings. Trapping, tagging, and testing of rodents was conducted approximately quarterly (five times) between September 2000 and September 2001. A total of 128 serum specimens, representing 90 individual rodents from seven species, were collected and tested. Antibody to Sin Nombre virus was detected in seven rodents: 1 of 2 (50%) *Microtus montanus*, 1 of 6 (16.7%) *Peromyscus crinitus*, 2 of 30 (6.7%) *Peromyscus maniculatus*, and 3 of 13 (23.1%) *Reithrodontomys megalotis*. Five of the seven positive rodents were collected from the riparian trap line, and one each from the oak woodland and building areas. *Peromyscus* spp. were more likely to be trapped in and around buildings in the summer (38% of total captures in June 2001) than in the fall (18% in September 2000). Trap success for *Peromyscus* spp. decreased from 22% in September 2000 to 6% in September 2001, suggesting a population decline, possibly due to unusually low precipitation. Concurrently, the recapture success declined throughout the first year of the study: 37% in December 2000, 31% in April 2001, 18% in June 2001, and 0% in September 2001. This study will continue during 2002.

[1] In addition to the DHS data presented here, the Orange County Vector Control District, in collaboration with the University of New Mexico, reported serologic evidence of Sin Nombre virus in 53 of 1024 rodents collected and tested in 2001.

Arenaviruses

Human case surveillance
No cases of arenavirus infection were detected in California residents in 2001.

Rodent surveillance
Surveillance for the arenavirus Whitewater Arroyo (WWA) in rodents was conducted in 13 California counties during 2001. A total of 1566 rodents were collected and serologically tested by the University of Texas Medical Branch-Galveston, representing at least 15 species from 10 genera (Table 3). At least one seroreactive rodent was detected in six counties (Table 4). Antibody to WWA was detected in five rodent species; seroprevalence was highest in *Neotoma fuscipes* at 4.4 percent. Arenavirus surveillance conducted by or reported to DHS since 1999 has identified serologic evidence of WWA infection in 30 (1.7 %) of 1761 rodents tested.

Report prepared by Curtis Fritz and Lawrence Bronson

Table 1. Serologic evidence of hantavirus (Sin Nombre) in California rodents, 1975-2001.

		2001			1975-2001		
Species	**Common name**	**No. collected**	**No. reactive**	**Percent**	**No. collected**	**No. reactive**	**Percent**
FAMILY MURIDAE							
SUBFAMILY SIGMODONTINAE (New World mice and rats)							
Neotoma fuscipes	dusky-footed woodrat	74	0		673	4	0.6
Neotoma lepida	desert woodrat	49	1	2.0	333	7	2.1
Neotoma sp.	other and unspecified *Neotoma*	9	0		70	2	2.9
Onychomys torridus	southern grasshopper mouse	0			1	0	
Peromyscus boylii	brush mouse	219	2	0.9	913	22	2.4
Peromyscus californicus	parasitic mouse	308	2	0.6	1205	23	1.9
Peromyscus crinitus	canyon mouse	12	0		99	4	4.0
Peromyscus eremicus	cactus mouse	108	1	0.9	504	8	1.6
Peromyscus maniculatus	deer mouse	375	43	11.5	5478	582	10.6
Peromyscus truei	piñon mouse	30	1	3.3	575	20	3.5
Peromyscus sp.	other and unspecified *Peromyscus*	0			104	12	11.5
Reithrodontomys megalotis [1]	western harvest mouse	41	2	4.9	424	51	12.0
Sigmodon hispidus	hispid cotton rat	0			22	0	
SUBFAMILY ARVICOLINAE (voles)							
Clethrionomys californicus	California red-backed vole	0			1	0	
Microtus californicus [2]	California vole	13	3	23.1	148	29	19.6
Microtus spp. [2]	other and unspecified *Microtus*	3	0		29	4	13.8
SUBFAMILY MURINAE (Old World mice and rats)							
Mus musculus	house mouse	5	0		235	0	
Rattus spp.	Norway rat & black rat	0	0		157	0	
FAMILY HETEROMYIDAE							
Chaetodipus spp.	pocket mice	96	0		282	2	0.7
Dipodomys spp.	kangaroo rat	4	0		71	1	1.4
Perognathus parvus	Great Basin pocket mouse	0			27	1	3.7
FAMILY SCIURIDAE (squirrels and chipmunks)							
Ammospermophilus leucurus	white-tailed antelope squirrel	1	0		5	0	
Glaucomys sabrinus	northern flying squirrel	0			1	0	
Sciurus griseus	western gray squirrel	0			1	0	
Spermophilus spp.	ground squirrels	0			1226	1	0.1
Tamias spp.	chipmunks	0			284	0	
Tamiasciurus douglasii	Douglas's squirrel	0			8	0	

[1] El Moro Canyon virus

[2] Isla Vista virus

Source: California Department of Health Services

Table 2. Serologic evidence of hantavirus (Sin Nombre) infection in *Peromyscus maniculatus*, by county, 1975-2001.

	2001			1975-2001		
County	**No. collected**	**No. reactive**	**Percent**	**No. collected**	**No. reactive**	**Percent**
Alameda				45	2	4.4
Alpine				55	11	20.0
Butte				115	14	12.2
Calaveras				45	9	20.0
Colusa				23	9	39.1
Contra Costa				36	0	
Del Norte				49	1	2.0
El Dorado				41	6	14.6
Fresno	46	16	34.8	508	75	14.8
Glenn				4	0	
Humboldt				55	5	9.1
Imperial				6	1	16.7
Inyo				75	5	6.7
Kern				129	10	7.8
Lake				22	1	4.5
Lassen	22	1	4.5	56	5	8.9
Los Angeles	42	0		379	16	4.2
Madera				62	8	12.9
Marin				105	3	2.9
Mariposa				46	7	
Mendocino				38	4	
Merced				68	4	5.9
Modoc	6	0		71	10	14.1
Mono				227	47	20.7
Monterey				106	9	8.5
Napa				24	0	
Nevada				150	52	34.7
Orange*				204	10	4.9
Placer				32	2	6.2
Plumas				67	14	20.9
Riverside	102	18	17.6	587	40	6.8
Sacramento				36	0	
San Bernardino	14	0		259	8	3.1
San Diego	79	3	3.8	346	17	4.9
San Francisco				30	0	
San Joaquin				11	1	9.1
San Luis Obispo				65	5	7.7
San Mateo	23	4	17.4	136	10	7.4
Santa Barbara	21	1	5.0	322	87	27.0
Santa Clara	11	0		43	0	
Shasta				32	4	12.5
Sierra				46	9	19.6
Siskiyou				117	12	10.3
Solano				3	0	
Sonoma				133	1	0.8
Stanislaus				15	0	
Tehama				35	5	14.3
Trinity				24	8	33.3
Tulare				20	2	10.0
Tuolumne				130	23	17.7
Ventura				190	10	5.3
Yolo				24	0	
Yuba	9	0		31	0	
Total	**375**	**43**	**11.5**	**5478**	**582**	**10.6**

* The Orange County Vector Control District (OCVCD) reported collecting 544 *P. maniculatus* in 2001, 47 (8.6%) of which were reported seropositive for SNV by the University of New Mexico. During 1991-2001, OCVCD reported 145 (6.9%) of 2106 *P. maniculatus* seropositive for SNV.

Source: California Department of Health Services

Table 3. Serologic evidence of arenavirus (Whitewater Arroyo) in California rodents, 1999-2001.

Species	Common name	2001 No. collected	2001 No. reactive	2001 Percent	1999-2001 No. collected	1999-2001 No. reactive	1999-2001 Percent
FAMILY MURIDAE							
SUBFAMILY SIGMODONTINAE (New World mice and rats)							
Neotoma fuscipes	dusky-footed woodrat	205	9	4.4	236	9	3.8
Neotoma lepida	desert woodrat	72	0		115	0	
Neotoma sp.	other and unspecified *Neotoma*	104	0		104	0	
Peromyscus boylii	brush mouse	47	1	2.1	48	1	2.1
Peromyscus californicus	parasitic mouse	96	2	2.1	110	2	1.8
Peromyscus eremicus	cactus mouse	111	2	1.8	125	2	1.6
Peromyscus maniculatus	deer mouse	699	16	2.3	741	16	2.2
Peromyscus truei	piñon mouse	0			16	0	
Peromyscus sp.	other and unspecified *Peromyscus*	1	0		1	0	
Reithrodontomys megalotis [1]	western harvest mouse	20	0		24	0	
SUBFAMILY ARVICOLINAE (voles)							
Microtus californicus [2]	California vole	4	0		11	0	
SUBFAMILY MURINAE (Old World mice and rats)							
Mus musculus	house mouse	146	0		157	0	
Rattus spp.	Norway rat & black rat	27	0		38	0	
FAMILY GEOMYIDAE (pocket gophers)							
Thomomys bottae	Botta's pocket gopher	1	0		1	0	
FAMILY HETEROMYIDAE							
Chaetodipus spp.	pocket mice	19	0		20	0	
Dipodomys spp.	kangaroo rat	13	0		13	0	
FAMILY SCIURIDAE (squirrels and chipmunks)							
Spermophilus spp.	ground squirrels	1	0		1	0	

Source: California Department of Health Services

Table 4. Serologic evidence of arenavirus (Whitewater Arroyo) in California rodents, by county, 1999-2001.

	2001			1999-2001		
County	**No. collected**	**No. reactive**	**Percent**	**No. collected**	**No. reactive**	**Percent**
Alameda	60	1	1.7	148	1	0.7
Contra Costa	0			12	0	
Fresno	59	1	1.7	59	1	1.7
Inyo	17	0		17	0	
Kern	15	1	6.7	15	1	6.7
Lassen	6	0		6	0	
Los Angeles	0			82	0	
Marin	214	1	0.5	214	1	0.5
Mono	1	0		1	0	
Orange	1134	22	1.9	1134	22	1.9
Santa Barbara	8	4	50.0	8	4	50.0
Santa Clara	22	0		35	0	
Tuolumne	20	0		20	0	
Ventura	9	0		9	0	
Yolo	1	0		1	0	
Total	**1566**	**30**	**1.9**	**1761**	**30**	**1.7**

Source: California Department of Health Services

Plague Surveillance and Control

The California Department of Health Services (DHS) cooperates with local, state, and federal agencies to conduct a statewide Plague Surveillance Program. DHS collects and collates information on suspect and confirmed plague activity among humans, domestic pets, and wild animals throughout California.

Human cases

There were no confirmed human plague cases in California in 2001.

Domestic pets

Veterinarians submitted specimens from four cats with clinical signs suggestive of plague to the DHS Microbial Diseases Laboratory for testing. Plague was confirmed in one cat from Beckworth, Plumas County. The cat developed fever (105 °F) and enlarged submandibular lymph nodes in April. The cat recovered without complications following treatment with antibiotics. Because the cat displayed no respiratory signs and was placed in strict isolation at the animal hospital, no antibiotic prophylaxis was recommended for the cat's owners or the veterinary staff. Surveillance in the surrounding Beckworth and Sierra Valley area detected antibody to *Yersinia pestis* in a coyote and a badger. The Plumas County Health Department issued a press release to advise area residents about plague in domestic pets and wildlife.

Wild animals

Blood samples from 367 wild carnivores from 26 California counties were collected and tested for antibody to *Y. pestis*; 26 (7.1%) were positive, including 18 of 237 coyotes and 6 of 35 black bears (Table 5). Sero-positive wild carnivores were identified in nine California counties: Alpine, El Dorado, Kern, Mariposa, Modoc, Placer, Plumas, San Bernardino, and Sierra.

Bacteriological and serological surveillance for plague in wild rodents was conducted in 20 California counties. *Y. pestis* antibody was detected in California ground squirrels or chipmunks at recreational sites in five counties (El Dorado, Inyo, Mono, San Diego, Ventura); all of these rodents were collected from sites where plague is recognized as historically enzootic. Flea suppression with 2% Diazinon insecticide dust was conducted at the sites in El Dorado, Inyo, Mono, and San Diego Counties.

Collaborative surveillance between VBDS and the U.S. Navy Disease Vector Ecology and Control Center detected a seropositive chipmunk at the Leavett Training Area, U.S. Marine Corps Mountain Warfare Training Center, Mono County, in June.

An active plague epizootic, confirmed by bacteriological and serological testing of rodents and rodent fleas, was detected in El Dorado County at South Lake Tahoe. *Y. pestis* was cultured from a yellow pine chipmunk which was found dead at the U.S. Forest Service Lake Tahoe Visitor Center. VBDS conducted follow-up environmental investigation and risk evaluation at the site and detected antibody to *Y. pestis* (titer range, 1:64 to 1:8192) in 8 of 16 chipmunks and cultured *Y. pestis* in fleas from chipmunks. VBDS applied 2% Diazinon insecticidal dust into rodent burrows to control fleas. The local vector control program posted plague warnings at all recreational sites within the greater South Lake Tahoe area. No additional rodent die-offs were reported and subsequent surveillance of rodents failed to detect *Y. pestis* antibody.

Report prepared by Charles Smith, Al Hom, Malcolm Thompson, and Curtis Fritz

Table 5. Plague positive mammals in California, 2001 (All specimens are serum except where otherwise indicated).

County Location[1]	No. rodents tested	No. carnivores tested	Positive specimens		
			Species	Result	Month
Alameda	18	0			
Alpine	0	4			
Gardnerville, 4SW			Coyote	1:128	March
Gardnerville, 4SW			Coyote	1:64	March
Contra Costa	1	7			
El Dorado	45	33			
NF So. Lake Tahoe Visitors' Center			CA G Sq	1:256	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:128	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:128	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:16	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:64	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:64	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:8192	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:8192	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	1:8192	July
NF So. Lake Tahoe Visitors' Center			Chipmunk, YP	POS[3]	July
So. Lake Tahoe			Chipmunk, YP	POS[4]	July
So. Lake Tahoe			Coyote	1:128	February
Tahoe Keys			Coyote	1:64	June
Fresno	5	9			
Inyo	22	0			
Inyo NF, Four Jeffrey CG			CA G Sq	1:64	June
Kern	93	22			
Caliente/Twin Oaks			Black bear	1:64	January
Frazier Park			Raccoon	1:64	August
Pine Mountain Club			Coyote	1:256	February
Pine Mountain Club			Coyote	1:512	February
Pine Mountain Club			Coyote	1:256	February
Twin Oaks			Black bear	1:32	August
Los Angeles [2]	0	15			
Mariposa	0	15			
Yosemite NP, Yosemite Valley			Black bear	1:128	October
Yosemite NP, Yosemite Valley			Black bear	1:256	October
Yosemite NP, Yosemite Valley			Black bear	1:256	October
Mendocino	0	21			
Modoc	6	30			
Alturas, 8E			Coyote	1:32	June
Cedarville, 3S			Coyote	1:128	June
Ft. Bidwell, 12N			Coyote	1:32	June
Likely, 15E			Coyote	1:64	June
Likely, 3W			Coyote	1:64	April

Source: California Department of Health Services

Table 5. Plague positive mammals in California, 2001 (All specimens are serum except where otherwise indicated). Continued.

County Location[1]	No. rodents tested	No. carnivores tested	Positive specimens		
			Species	Result	Month
Mono	71	0			
DOD, USMC Mtn Warfare Training Center			Chipmunk, LP	1:512	June
Inyo NF, Big Springs CG			CA G Sq	1:2048	August
Inyo NF, Crestview guard/fire station			Chipmunk	1:512	August
Monterey	28	0			
Nevada	4	7			
Orange	0	11			
Placer	1	28			
Roseville, 4NE			Coyote	1:128	January
Plumas	9	10			
Beckwourth			Domestic cat	POS	April
Beckwourth, 4E			Badger	1:32	May
Beckwourth, 5E			Coyote	1:64	April
Riverside	215	4			
Sacramento	0	2			
San Bernardino	263	29			
Hesperia			Coyote	1:128	March
I-215 & Devore Rd			Coyote	1:128	July
Phelan, 5W of I-15			Coyote	1:128	April
Running Springs			Black bear	1:128	June
San Diego	18	5			
William Heise County park			CA G Sq	1:64	June
William Heise County park			CA G Sq	1:64	June
William Heise County park			CA G Sq	1:64	June
William Heise County park			CA G Sq	1:128	July
William Heise County park			CA G Sq	1:256	July
William Heise County park			CA G Sq	1:512	August
William Heise County park			CA G Sq	1:512	August
William Heise County park			CA G Sq	1:256	August
William Heise County park			CA G Sq	1:256	August
William Heise County park			CA G Sq	1:128	September
William Heise County park			CA G Sq	1:128	September
William Heise County park			CA G Sq	1:256	September
William Heise County park			CA G Sq	1:256	September
William Heise County park			CA G Sq	1:32	September
William Heise County park			CA G Sq	1:256	September
William Heise County park			CA G Sq	1:512	October
William Heise County park			CA G Sq	1:256	October
William Heise County park			CA G Sq	1:512	October
San Luis Obispo	1	12			

Source: California Department of Health Services

Table 5. Plague positive mammals in California, 2001 (All specimens are serum except where otherwise indicated). Continued.

County Location[1]	No. rodents tested	No. carnivores tested	Positive specimens		
			Species	Result	Month
San Mateo	40	0			
San Bruno Mountain			Meadow Vole, MC	1:128	July
Santa Barbara	26	7			
Santa Clara	15	28			
Santa Cruz	0	22			
Shasta	0	6			
Sierra	0	6			
Sierraville, 3S			Coyote	1:32	May
Sonoma	0	14			
Ventura	58	4			
Los Padres NF, Chuchupate CG			CA G Sq	1:32	May
Los Padres NF, Chuchupate CG			Chipmunk, M	1:64	May
Los Padres NF, Chuchupate CG			CA G Sq	1:64	May
Yuba	0	16			

[1] Mileage and direction from nearest town may be indicated

[2] Plague surveillance and test results submitted by Los Angeles County Department of Health Services

[3] Carcass

[4] Fleapool

Abbreviations

Location: AFB, Air Force Base
NF, National Forest
NP, National Park
CG, Campground
SP, State Park

Species: CA G Squirrel, California ground squirrel
GM G Squirrel, Golden-mantled ground squirrel
Chipmunk LP, Lodgepole chipmunk
Chipmunk M, Merriam's chipmunk
Chipmunk YP, Yellow-pine chipmunk
Woodrat DF, Dusky-footed woodrat

Result: POS, *Y. pestis* recovered by culture
1:n, positive antibody titer by passive or indirect hemmagglutination test

Source: California Department of Health Services

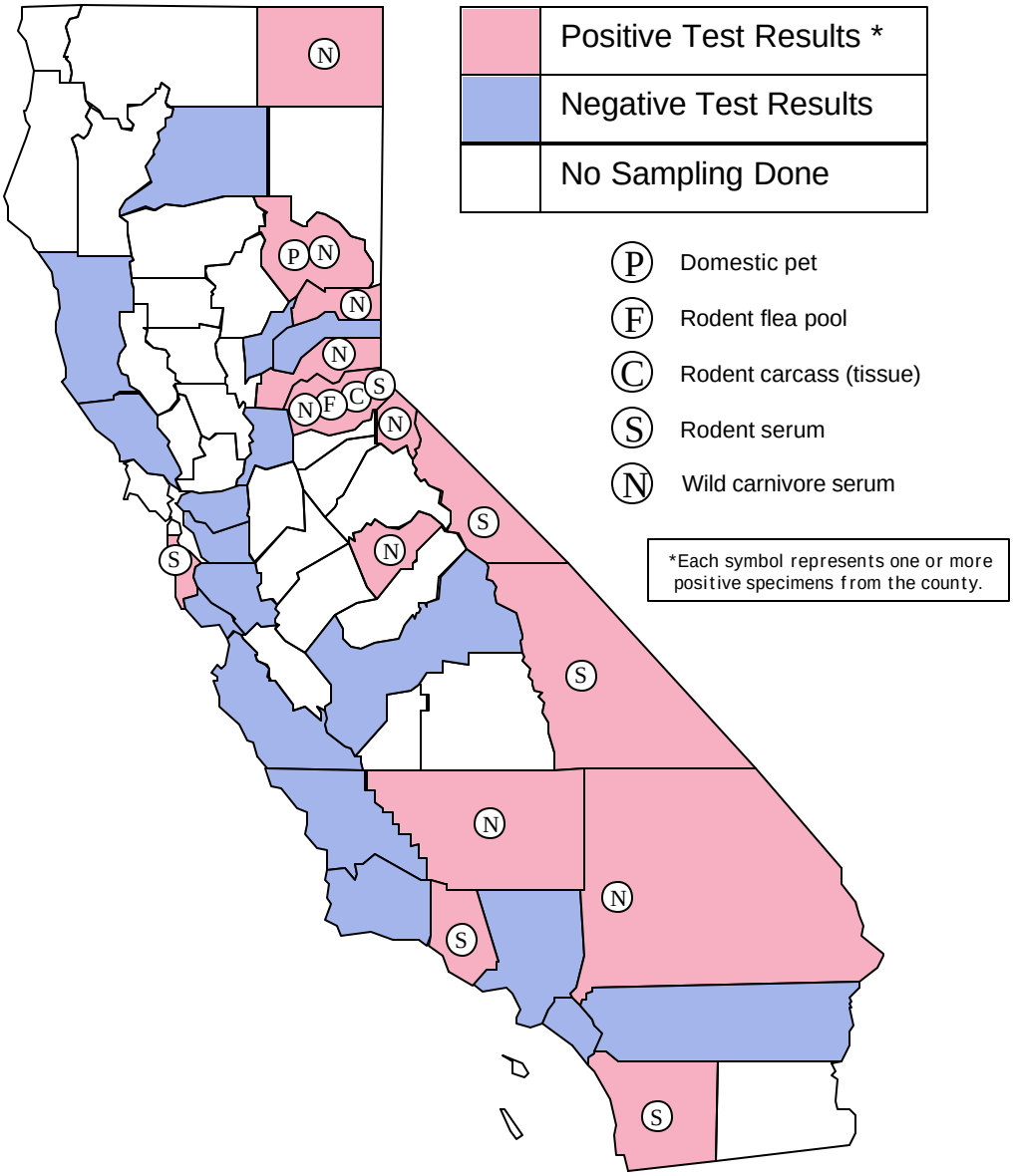


Figure 1. Distribution of plague-positive specimens by county, 2001.

Source: California Department of Health Services

Tick-borne Disease Surveillance

Ehrlichiosis

Two cases of ehrlichiosis were confirmed in California in 2001. In October 2000, a 73-year-old male resident of Marin County was hospitalized with fever, chills, night sweats, and myalgia of one to two weeks duration. Leukopenia, thrombocytopenia, and elevated liver enzymes were noted. Inclusion bodies resembling *Ehrlichia* morulae were observed in granulocytes. Serum collected in December and forwarded to the California Department of Health Services (DHS) Viral and Rickettsial Diseases Laboratory was positive (1:256) for antibody to *Ehrlichia equi* (recently renamed *Anaplasma phagocytophila*). The patient had no history of travel outside Marin County prior to onset of illness, but reported frequently hiking in the area around his residence. Staff of the Vector-Borne Disease Section (VBDS) and the Marin-Sonoma Mosquito and Vector Control District (MVCD) collected 20 adult *Ixodes pacificus* ticks from the case-patient's residential property. All ticks were negative by polymerase chain reaction (PCR) for *E. equi*.

A six-year-old male resident of Los Angeles County experienced recurrent fever and malaise beginning in mid-August. He was hospitalized for four days in early September with leukopenia, thrombocytopenia, and elevated liver enzymes. Serum specimens were positive for *E. equi* by both PCR and immunofluorescent antibody assay (1:4096). The patient had traveled to Marin County between late July and mid-August. His parents reported removing two ticks from him. VBDS and the Marin-Sonoma MVCD conducted tick surveillance in two areas along a roadway in Marin County where the patient had been. A total of 11 nymphal *I. pacificus* were collected and submitted to the Centers for Disease Control and Prevention for testing; no evidence of infection with *Ehrlichia* spp. was detected.

Lyme disease

A total of 94 cases of Lyme disease were reported to DHS in 2001. Case-patients were residents of 33 counties (Table 6). Los Angeles and Santa Cruz Counties reported the most cases (nine each), followed by Nevada and Sonoma Counties (six each). Population-adjusted incidence was highest in Trinity County at 7.7 cases per 100,000 residents (Figure 2). Of 73 cases for whom county of likely exposure was reported, 26 (36%) indicated exposure outside their county of residence; 16 (22%) of these reported exposure outside California. The most frequently reported locations of exposure were Contra Costa (5) and Santa Cruz (7) Counties, and the state of Massachusetts (6).

The median age of reported Lyme disease cases was 41 years (range, <1 to 82 years) and 52 (57%) were female. Of 87 cases for which race was reported, 80 (92%) were white. Erythema migrans (EM) was identified in 55 (60%) reported Lyme disease cases. Of 47 cases with EM for which date of illness onset was reported, 24 (51%) occurred between May and August. Twenty-eight (51%) cases with EM had a recognized tick bite prior to onset of illness.

In 2001, tick surveillance was conducted in 13 counties. A total of 2504 adult and nine nymphal *I. pacificus* and 156 adult *Dermacentor occidentalis* were collected from Calaveras, Inyo, Los Angeles, Madera, Marin, Monterey, Riverside, San Bernardino, San Luis Obispo, Shasta, Solano, Sonoma, and Tulare counties.

A ten-year study of *I. pacificus* population dynamics in Sonoma County culminated in 2001. At biweekly intervals, generally from late September to early June, tick abundance was assessed

along two trails, approximately 200 meters apart. In 2000-2001, the first date of appearance of *I. pacificus* adult ticks was October 12, 2000 (Figure 3). Total tick abundance for both trails peaked on November 28, 2000, at 83 ticks/100 m. The date of first appearance and peak abundance for 2000-2001 was typical of the previous nine years of surveillance in which the date of first appearance was in early fall (range, October 6 to November 1) and tick abundance peaked in late November to early January. The greatest abundance of ticks during the ten-year period was 195 ticks/100m on December 12, 1994. Although the patterns of abundance were similar between the two sites (e.g. dates of peak abundance were similar), the estimated density of ticks differed up to two-fold. These data indicate that the risk of encountering a tick can vary dramatically within a short range (< 200 meters). Weather conditions play a role in tick abundance; the associations between weather and tick abundance observed in this study will be further evaluated.

In 2001, a total of 2170 *I. pacificus* adult ticks, collected by VBDS and collaborating agencies, were tested for *Borrelia* spirochetes by five different laboratories. VBDS enhanced tick-testing capabilities in 2001 by developing its in-house direct fluorescent antibody (DFA) test. In addition to VBDS, outside collaborating laboratories used three different techniques – indirect fluorescent antibody, culture, and PCR – which vary in their sensitivity and specificity for *Borrelia* spirochetes. Of the total ticks submitted in 2001, 2044 from six counties (Los Angeles, Monterey, Riverside, San Luis Obispo, Shasta, and Sonoma) were tested by PCR by the U.S. Army Center for Health Promotion and Preventive Medicine-West. Ticks positive for *Borrelia* spirochetes were identified from Monterey, Riverside, San Luis Obispo, and Sonoma Counties (Table 7). The spirochetes were molecularly characterized as being closely related to *Borrelia* spirochetes recently identified from *Ixodes scapularis* ticks in the northeastern U.S. (*Vect Borne Zoonotic Dis,* 2001; 1: 21-34). Also in Monterey County, one tick was found positive for *Borrelia* spirochetes (uncharacterized) by VBDS. In Shasta County, one out of 132 adult *I. pacificus* ticks was found positive for *Borrelia burgdorferi* by the Washoe County Environmental Health Department of Nevada.

In collaboration with local health departments and mosquito and vector control districts, VBDS has conducted a cooperative surveillance program for identifying *B. burgdorferi* in *I. pacificus* ticks since 1985. A total of 17,676 adult and 563 nymphal *I. pacificus* have been tested by various laboratories (Table 8). Positive ticks were identified in 36 counties (Table 9, Figure 4). In addition to DHS data postive ticks have been reported in Marin, Contra Costa, Monterey, Orange, and San Diego counties by University of California, Berkeley, Contra Costa County MVCD, Orange County Vector Control District, and San Diego County Environmental Health Department, respectively.

Rocky Mountain spotted fever

No cases of Rocky Mountain spotted fever (RMSF) were reported in 2001.

In April, VBDS completed an investigation of a case of RMSF reported from San Bernardino County in 2000. The patient was a 29-year-old male who developed fever, headache, and myalgia in mid-April. The patient was a warden for the California Department of Fish & Game who had worked in the Silverwood Lake Recreation Area, in the San Bernardino Mountains, approximately one week prior to onset of illness. He recalled finding ticks on his clothing and possibly a tick bite on his neck. VBDS surveyed the area of putative exposure and collected five *I. pacificus* and five *D. occidentalis* ticks. All ticks were submitted to the National Institutes of Health Rocky Mountain Laboratories for culture: all were negative.

Tick-borne relapsing fever

Seven cases of tick-borne relapsing fever were reported among California residents in 2001. Four of these cases were Nevada County residents whose illnesses were part of a single outbreak. All four patients were seen at a local hospital on June 2 with fever, chills, and generalized muscle pain. The DHS Microbial Diseases Laboratory observed *Borrelia* sp. spirochetes on blood smears from three of the patients. All patients were treated with doxycycline and recovered, although two required brief hospitalization.

The patients reported having visited cabins and abandoned mines in restricted Bureau of Land Management property in western Nevada State during May 23-28. Three of the case-patients reported having slept in the same cabin. Of the 13 other persons in the party, none was reported to have developed similar illness.

Officials of the Nevada State Health Department inspected the cabins and noted that they were in considerable disrepair and had evidence of extensive rodent infestation. Because of the remote location and restricted accessibility of these cabins, the public health risk was adjudged to be minimal and no rodent abatement efforts were attempted nor recommended to the land manager.

Four illnesses compatible with relapsing fever occurred among visitors to an Inyo National Forest cabin in July. Ill persons were California and Nevada residents who participated in a seven-day business retreat in Crestview in mid-July. All four developed fever, up to 106 °F, one to three days after leaving the cabin, with at least three requiring hospitalization. *Borrelia* were observed on blood smear of one patient. VBDS biologists, in collaboration with Mono County Department of Environmental Health, inspected the cabins where the patients were likely exposed and provided recommendations for rodent control and exclusion.

Report prepared by Lucia Hui, Curtis Fritz, Anne Kjemtrup, Marty Castro, and Malcolm Thompson

Table 6. Reported Lyme disease cases by county of residence, California, 1992-2001.

County	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	Reported cases per 100,000 person-years
Alameda	4	7	1	2	2	3	6	3	4	4	0.24
Alpine	0	0	0	0	0	0	0	0	0	0	0.00
Amador	0	0	0	0	0	0	0	1	0	1	0.57
Butte	0	3	0	1	4	53	13	18	3	2	4.69
Calaveras	1	0	0	0	0	0	0	0	1	0	0.49
Colusa	0	0	0	0	0	0	0	0	0	0	0.00
Contra Costa	2	4	2	0	1	6	2	1	1	5	0.25
Del Norte	0	3	0	2	0	1	0	1	0	0	2.53
El Dorado	0	0	2	4	0	3	2	1	0	0	0.75
Fresno	2	3	0	0	1	0	0	0	1	0	0.09
Glenn	5	0	0	0	0	2	0	1	1	0	3.36
Humboldt	17	6	2	4	5	19	20	14	10	4	7.95
Imperial	0	0	0	0	0	1	0	0	0	0	0.07
Inyo	0	0	0	0	0	0	0	0	0	1	0.55
Kern	4	2	2	1	1	2	2	2	2	0	0.27
Kings	0	0	0	0	0	0	0	0	0	0	0.00
Lake	7	6	1	2	0	1	2	1	0	1	3.57
Lassen	0	0	0	0	0	2	1	2	0	0	1.46
Los Angeles	9	3	2	5	2	6	3	7	2	9	0.05
Madera	0	1	0	0	0	0	0	1	0	0	0.16
Marin	6	4	2	10	0	4	8	4	3	1	1.70
Mariposa	1	0	0	0	0	0	0	0	0	0	0.59
Mendocino	32	23	4	12	3	2	16	8	7	4	12.77
Merced	0	0	0	0	0	2	0	1	1	0	0.19
Modoc	0	0	0	0	0	0	0	0	0	0	0.00
Mono	1	0	0	1	1	0	0	1	0	0	3.11
Monterey	0	4	1	2	0	2	1	2	1	0	0.32
Napa	1	2	0	0	1	3	0	2	2	3	1.12
Nevada	4	5	8	0	2	1	4	5	9	6	4.77
Orange	6	3	0	0	0	0	1	2	3	0	0.05
Placer	2	2	2	1	0	5	4	2	1	4	0.92
Plumas	1	0	0	1	3	0	2	1	0	1	4.34
Riverside	4	3	2	0	1	0	0	0	3	2	0.10
Sacramento	0	1	0	1	0	5	1	1	3	4	0.13
San Benito	0	0	0	0	0	0	0	0	0	1	0.19
San Bernardino	7	1	3	1	0	0	0	1	1	0	0.08
San Diego	5	4	7	6	5	4	0	16	9	3	0.21
San Francisco	2	2	1	1	4	1	7	1	2	3	0.31
San Joaquin	0	1	2	0	1	2	0	0	0	0	0.11
San Luis Obispo	2	1	1	0	1	0	1	1	1	0	0.32
San Mateo	4	3	2	1	2	3	4	4	2	4	0.41
Santa Barbara	2	1	0	3	1	1	3	0	0	1	0.30
Santa Clara	6	2	3	2	2	4	6	2	2	2	0.18
Santa Cruz	4	5	2	3	2	2	2	2	5	9	1.40
Shasta	6	0	3	1	1	0	2	0	0	2	0.91
Sierra	0	0	0	0	0	0	0	0	0	0	0.00
Siskiyou	0	2	1	0	0	1	1	0	0	1	1.34
Solano	2	0	0	0	0	0	0	0	1	1	0.10
Sonoma	37	20	3	11	13	10	15	14	8	6	2.97
Stanislaus	0	1	1	0	3	1	0	0	1	1	0.18
Sutter	1	1	0	0	0	1	0	0	1	1	0.63
Tehama	1	0	1	0	0	1	1	0	2	0	1.08
Trinity	33	1	0	0	1	0	1	13	1	1	39.23
Tulare	3	1	3	1	1	0	1	1	0	2	0.35
Tuolumne	1	1	0	0	1	0	0	0	0	2	0.91
Ventura	2	1	0	0	0	0	2	1	2	2	0.13
Yolo	0	1	1	0	0	0	0	0	0	0	0.12
Yuba	1	0	3	1	0	0	1	1	0	0	1.15
Total	**228**	**134**	**68**	**80**	**65**	**154**	**135**	**139**	**96**	**94**	**0.35**

Source: California Department of Health Services

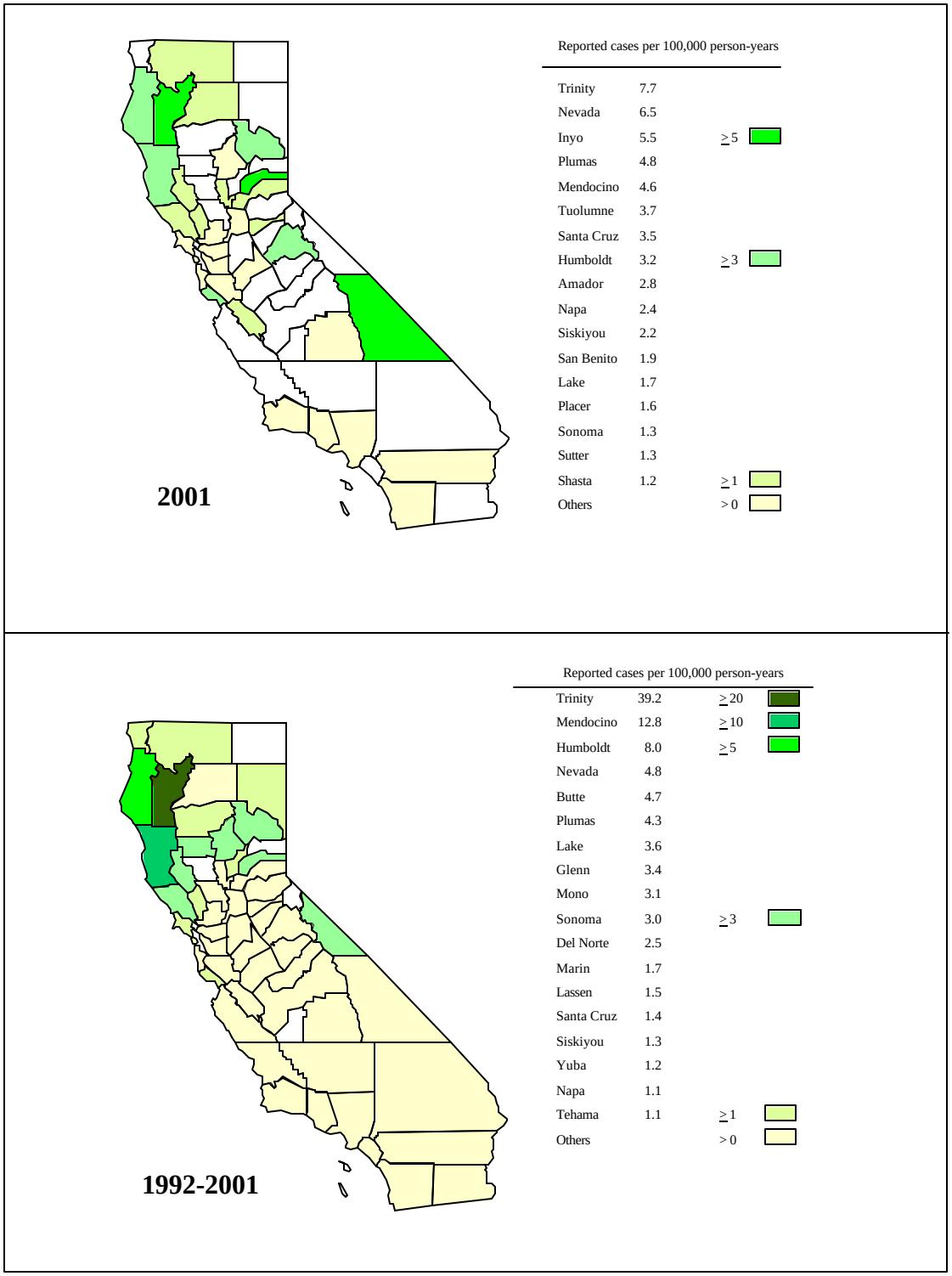


Figure 2. Reported incidence of Lyme disease by county, California.

Source: California Department of Health Services

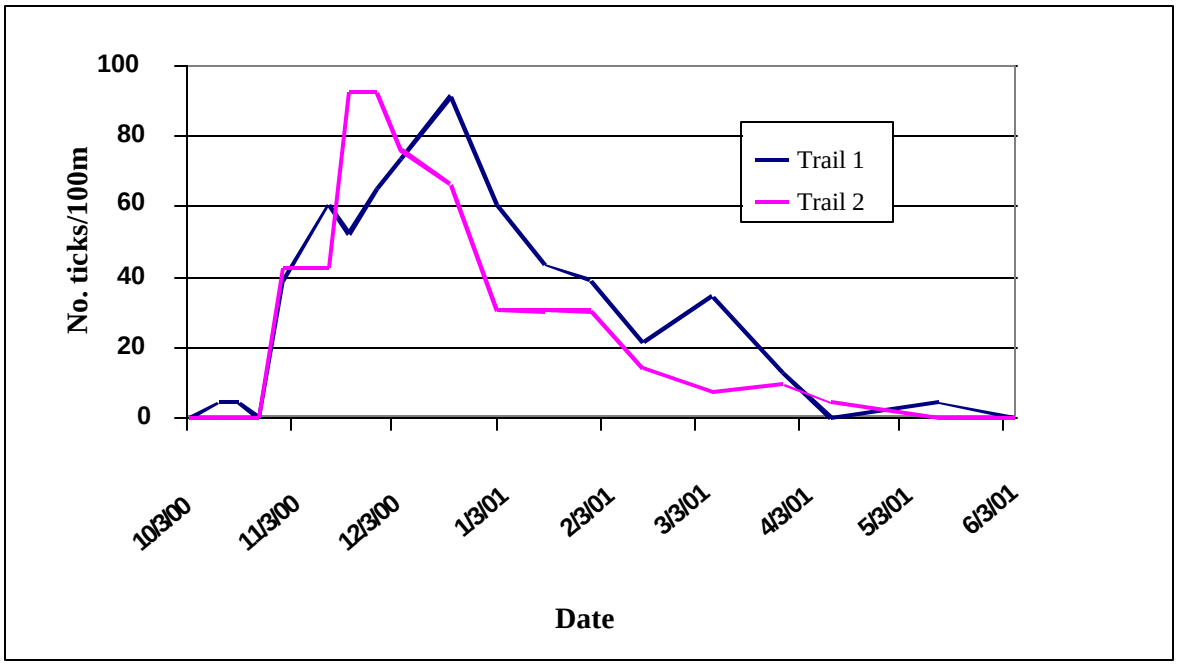


Figure 3. *Ixodes pacificus* adult tick collection at two trails in Sonoma County, 2000-2001.

Source: California Department of Health Services

Table 7. *Ixodes pacificus* adult ticks from California tested for evidence of *Borrelia* species[a], 2001.

County	Location	No. ticks	No. pools	No. pools positive				Laboratory
				Culture	DFA	IFA	PCR	
Inyo	Inyo NF, Lewis Canyon	14	14	0	-	-	-	UC Berkeley
	Inyo NF, Sage Flat Road	1	1	0	-	-	-	UC Berkeley
Los Angeles	Angeles NF, Chantry Flat	152	15	-	-	-	0	US Army
	Angeles NF, Rowher Flat OMU Area	24	3	-	-	-	0	US Army
	Angeles NF, Santa Clarita	77	8	-	-	-	0	US Army
	Angeles NF, South Fork Trail	188	19	-	-	-	0	US Army
	Angeles NF, Switzer Picnic HWY 2	58	6	-	-	-	0	US Army
	Griffith Park Drive Trail	51	5	-	-	-	0	US Army
	Griffith Park, Los Angeles 5 Points	173	18	-	-	-	0	US Army
	Los Angeles, O'melveney Park	121	12	-	-	-	0	US Army
	Monrovia, Monrovia Canyon Park	72	7	-	-	-	0	US Army
	Tarzana, Caballero Canyon Fire Road	33	3	-	-	-	0	US Army
Monterey	Los Padres NF, Arroyo Seco CG	44	44	-	1	-	-	DHS, VBDS
	Los Padres NF, Arroyo Seco CG	157	17	-	-	-	2	US Army
Riverside	Cleveland NF, Ortega Mtns	105	12	-	-	-	0	US Army
	Cleveland NF, Santa Rosa Plateau	143	16	-	-	-	0	US Army
	San Bernard NF, Cranston Station	65	9	-	-	-	0	US Army
	San Bernard NF, Gardner Valley	194	22	-	-	-	2	US Army
	San Bernard NF, Silent Valley	150	17	-	-	-	0	US Army
San Bernardino	Silverwood Lake St Pk, Recreation Area	5	1	-	-	0	-	Rocky Mt Lab
San Luis Obispo	Los Padres NF, Cerro Alto Campground	100	10	-	-	-	3	US Army
Shasta	Shasta NF, Fenders Flat, Fenders Ferry B	30	3	-	-	-	0	US Army
	Shasta NF, Potem Falls, Potem Creek	40	4	-	-	-	0	US Army
	Shasta NF, Shasta Lake, Dekkas Rock	33	33	-	-	1[b]	-	Washoe Co EH
	Shasta NF, Shasta Lake, Hirtz Bay CG	29	29	-	-	0	-	Washoe Co EH
Sonoma	Sonoma Development Center	111	12	-	-	-	1	US Army
Totals		**2170**						

[a] "*Borrelia* species" indicates bacterial organisms in the *Borrelia* genus, not necessarily *Borrelia burgdorferi*.

[b] Identified as *B. burgdorferi*

Location: NF, National Forest; NP, National Park; SP, State Park; CG, Campground

Test: DFA, Direct fluorescent antibody; IFA, Indirect fluorescent antibody; PCR, Polymerase chain reaction

Laboratory: EH, Environmental Health; DHS, VBDS, California Department of Health Services, Vector-Borne Disease Section

Source: California Department of Health Services

Table 8. *Ixodes pacificus* ticks tested for *Borrelia burgdorferi*, California, 1985-2001 (n=18,239).

County	Stage	Total no. pooled ticks by test method[1]				No. positive pools	MIP %[2]
		Culture	DFA	IFA	PCR		
Alameda	A	126	-	-	-	3	2.38
	A	-	-	531	-	3	0.56
Amador	A	47	-	-	-	1	2.13
Butte	A	162	-	-	-	1	0.62
	A	-	-	130	-	5	3.85
Calaveras	A	44	-	-	-	1	2.27
Contra Costa	A	515	-	-	-	0	0.00
Del Norte	A	77	-	-	-	2	2.60
	A	-	2	-	-	0	0.00
	A	46	-	-	-	1	2.17
El Dorado	A	112	-	-	-	1	0.89
Fresno	A	68	-	-	-	1	1.47
	A	-	-	-	16	0	0.00
Glenn	A	84	-	-	-	2	2.38
Humboldt	A	670	-	-	-	6	0.90
	N	1	-	-	-	0	0.00
Inyo	A	15	-	-	-	0	0.00
	A	-	-	7	-	0	0.00
Kern	A	205	-	-	-	2	0.98
Lake	A	129	-	-	-	2	1.55
Los Angeles	A	937	-	-	-	1	0.11
	A	-	428	-	-	0	0.00
	A	-	-	1494	-	9	0.60
	A	-	-	-	1019	0	0.00
Madera	A	196	-	-	-	1	0.51
Mariposa	A	98	-	-	-	4	4.08
	A	-	-	330	-	6	1.82
Mendocino	A	572	-	-	-	10	1.75
	A	-	-	210	-	0	0.00
	N	322	-	-	-	35	10.87
Monterey	A	106	-	-	-	0	0.00
	A	-	-	-	238	0	0.00
	N	-	-	-	1	0	0.00
Napa	A	209	-	-	-	2	0.96
Nevada	A	263	-	-	-	3	1.14
	A	-	-	299	-	3	1.00
	N	-	-	8	-	0	0.00
Orange	A	363	-	-	-	0	0.00
Placer	A	189	-	-	-	4	2.12
Plumas	A	154	-	-	-	1	0.65
Riverside	A	157	-	-	-	0	0.00
	A	-	-	214	-	0	0.00
	A	-	-	-	1010	0	0.00
Sacramento	A	231	-	-	-	6	2.60
San Benito	A	258	-	-	-	1	0.39
San Bernardino	A	57	-	-	-	2	3.51
	A	-	-	5	-	0	0.00
	A	-	-	-	4	0	0.00

Source: California Department of Health Services

Table 8. *Ixodes pacificus* ticks tested for *Borrelia burgdorferi*, California, 1985-2001 (n=18,239). Continued.

County	Stage	Total no. pooled ticks by test method[1]				No. positive pools	MIP %[2]
		Culture	DFA	IFA	PCR		
	A	-	-	98	-	0	0.00
San Luis Obispo	A	626	-	-	-	0	0.00
San Mateo	A	-	-	88	-	0	0.00
	A	-	-	-	230	0	0.00
	A	160	-	-	-	3	1.88
Santa Barbara	A	442	-	-	-	0	0.00
	A	-	-	328	-	0	0.00
	A	-	-	-	44	1	2.27
	N	-	-	-	23	0	0.00
	N	52	-	-	-	0	0.00
	L	-	-	-	95	1	1.05
Santa Clara	A	54	-	-	-	1	1.85
Santa Cruz	A	130	-	-	-	1	0.77
	N	40	-	-	-	0	0.00
Shasta	A	81	-	-	-	1	1.23
	A	-	-	155	-	2	1.29
	A	-	-	-	70	0	0.00
Sierra	A	-	-	93	-	4	4.30
Siskiyou	A	114	-	-	-	1	0.88
Solano	A	51	-	-	-	0	0.00
	A	-	-	70	-	0	0.00
Sonoma	A	642	-	-	-	9	1.40
	A	-	-	-	139	0	0.00
	N	-	-	-	4	0	0.00
Tehama	A	204	-	-	-	1	0.49
	A	-	-	39	-	1	2.56
Trinity	A	238	-	-	-	2	0.84
	A	-	-	55	-	0	0.00
Tulare	A	108	-	-	-	2	1.85
	A	-	-	-	175	1	0.57
	N	3	-	-	-	0	0.00
	N	-	-	-	2	0	0.00
Tuolumne	A	130	-	-	-	2	1.54
Ventura	A	355	-	-	-	0	0.00
Yolo	A	51	-	-	-	0	0.00
	A	-	-	200	-	3	1.50
	N	107	-	-	-	2	1.87
Yuba	A	11	-	-	-	0	0.00
	A	-	-	65	-	2	3.08

[1] Total tick numbers by method are combined from 1985-2001 and may represent multiple laboratories. Tick pool sizes vary between testing methods and testing laboratories.

Test Method: DFA, Direct Fluorescent Antibody Test
IFA, Indirect Fluorescent Antibody Test
PCR, Polymerase Chain Reaction

[2] MIP%: Minimum Infection Proportion percent = (No. positive pools/Total no. of ticks tested) * 100.

Source: California Department of Health Services

Table 9. Surveillance sites for *Borrelia burgdorferi* in *Ixodes pacificus* by county, 1985-2001.

County	No. of sites surveyed	No. positive sites	Positive site location
Alameda	4	3	Del Valle Regional Park; Roberts Regional Park; Sunol Regional Park
Amador	2	1	Pioneer
Butte	4	2	Big Bend; Oroville (7 miles east)
Calaveras	1	1	Murphys
Contra Costa	2	0	
Del Norte	5	2	Del Norte SP (Enderts Beach); Six Rivers NF (Big Flat CG)
El Dorado	2	1	Georgetown
Fresno	7	1	Sierra NF (Kirch Flat CG)
Glenn	3	1	Elk Creek, (10 miles west of Ivory Mill Road)
Humboldt	20	3	Ettersburg; Redway; Salmon Creek
Inyo	2	0	
Kern	3	1	Fort Tejon SP
Lake	4	2	Clear Lake SP; Upper Lake
Los Angeles	46	4	Malibu (Charmlee Park); Pacific Palisades (Will Rogers SP); Palos Verdes (Bluff Cove); Tapia Spur Trail
Madera	5	1	Sierra NF (Bass Lake)
Mariposa	5	3	Mariposa; Miami Mountain; Yousemite NP (Wawona CG)
Mendocino	14	5	Lake Mendocino; Laytonville; Potter Valley; Whale Culch; Willits
Monterey	5	0	
Napa	4	1	Oakville
Nevada	5	4	Grass Valley; Nevada City; South Yuba River SP (Independence Trail and Pleasant Valley Road)
Orange	5	0	
Placer	3	2	Auburn; Auburn State Recreation Area
Plumas	3	1	Plumas NF (Tobin, 1 mile north of Highway 70)
Riverside	9	0	
Sacramento	3	1	Folsom
San Benito	6	1	Beaver Dam Fire Station
San Bernardino	6	1	Cucamonga
San Diego	5	0	
San Luis Obispo	9	0	
San Mateo	2	1	La Honda
Santa Barbara	13	1	Vandenberg Air Force Base
Santa Clara	1	1	Mt. Madonna county park
Santa Cruz	7	1	Camp Loma (4-H)
Shasta	12	3	Bear Creek Bridge; Shasta NF (Pollard Gulch Recreation Area and Shasta Lake-Dekkas Rock)
Sierra	2	1	Tahoe NF(Ramshorn CG)
Siskiyou	4	1	Klamath NF (Seiad Valley)
Solano	2	0	
Sonoma	9	4	Annadel SP; Armstrong Wood SP; Mark West Springs; Santa Rosa
Tehama	7	2	Lassen NF (Black Rock CG): Maple Creek (near Saddle Camp)
Trinity	11	2	Price Creek; Weaverville
Tulare	12	2	Sequoia NP (Ash Mountain and Potwisha CG)
Tuolumne	2	1	Columbia
Ventura	6	0	
Yolo	3	2	Cache Creek; Cache Creek Canyon RP (Rayhouse Rd)
Yuba	3	1	Tahoe NF(Camptonville)
Totals	**288**	**65**	

Abbreviations: SP=State Park; CG=Campground; NF=National Forest; NP=National Park

Source: California Department of Health Services

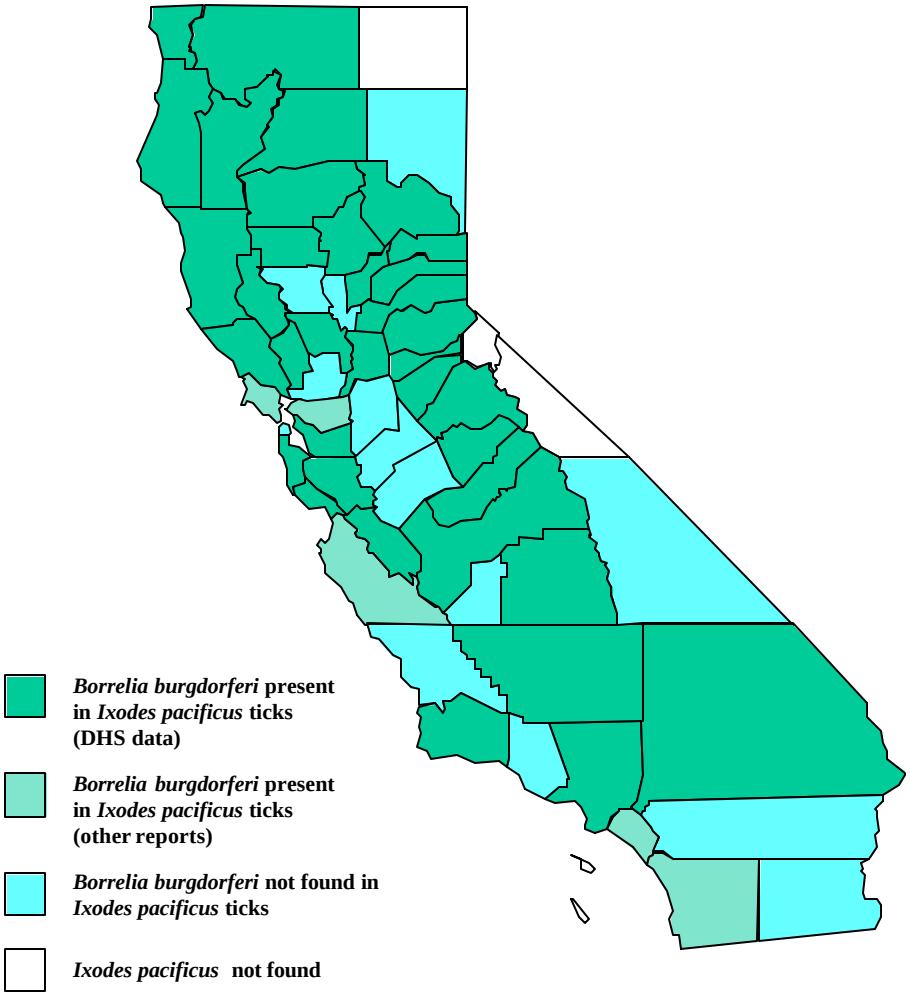


Figure 4. *Borrelia burgdorferi* in *Ixodes pacificus* ticks (1985-2001). This map generalizes available data and patterns may vary within counties.

Source: California Department of Health Services

Mosquito-borne Encephalitis Virus Surveillance

The California Mosquito-Borne Encephalitis Surveillance Program is a cooperative effort of the California Department of Health Services (DHS) Division of Communicable Disease Control, the University of California at Davis and Berkeley, the Mosquito and Vector Control Association of California (MVCAC), local mosquito and vector control agencies, local health departments, physicians, veterinarians, and other interested parties. Collaborating agencies in the West Nile virus (WNV) surveillance program include the California Department of Food and Agriculture (CDFA), California Animal Health and Food Safety Laboratory (CAHFS), California Department of Fish and Game (DFG), the U.S. Fish and Wildlife Service (USFWS), and the Centers for Disease Control and Prevention (CDC).

The program included the following components:

1) Diagnostic testing of specimens from human patients exhibiting symptoms of viral meningitis or encephalitis.
2) Enrollment of patients diagnosed with encephalitis into the California Encephalitis Project (CEP) which evaluates demographics, clinical symptomatology, exposure to arthropods, and laboratory analyses to determine etiology.
3) Diagnostic testing of specimens from equids that exhibited clinical signs of viral neurologic disease compatible with arboviral infection (western equine encephalomyelitis [WEE], WNV, and other arboviruses as appropriate)
4) Monitoring and testing of mosquitoes for the presence of St. Louis encephalitis (SLE) and WEE viruses. Tests were also done on a limited basis for WNV, California encephalitis (CE), dengue, and other arboviruses.
5) Serological monitoring of sentinel chickens for SLE and WEE antibodies in areas of California where evidence of encephalitis virus activity has occurred historically. Chicken sera from geographic areas where SLE seroconversions occurred and specimens from other regions were also tested for WNV.
6) Surveillance and diagnostic testing of dead birds, especially crows, for WNV.
7) Weekly reporting in the DHS arbovirus surveillance bulletin of the arbovirus testing results in California and arbovirus activity throughout the United States.

Human disease surveillance

The DHS Viral and Rickettsial Disease Laboratory (VRDL) tested sera and/or cerebrospinal fluid specimens from 210 patients exhibiting symptoms of viral meningitis or encephalitis for antibodies to SLE and WEE viruses. Neither elevated IgM antibody nor a four-fold rise in total antibody titer between paired sera was observed in any of the suspect cases.

Of the 210 patients tested, 167 were enrolled in the CEP. For each patient enrolled, a battery of tests was conducted, including polymerase chain reaction, serology, and viral isolation for 15 agents. Testing for additional etiologic agents was pursued as clinical symptomatology and exposure history warranted; extensive testing for arboviruses was conducted for cases with known mosquito exposure and those with a travel history to an area of WNV activity. No cases of SLE or WEE were identified through the CEP. Assays for antibody to WNV were performed for all patients enrolled in 2001. Of these patients, 28 had recent mosquito exposure and six had traveled to the eastern United States within the incubation time for WNV. No cases of WNV were identified.

Equine surveillance
Serum and brain tissue specimens from 13 horses displaying neurological signs were submitted for arboviral testing to the UC Davis Arbovirus Research Unit (DARU). Testing failed to detect antigen or antibody for WEE or WNV.

Adult mosquito surveillance
Forty local agencies from 32 counties initiated weekly adult mosquito collection in April 2001 using a total of 573 New Jersey light traps (Table 10). Data from these sources were forwarded to DHS and collated weekly into the Adult Mosquito Occurrence Summary Report from April 4 - October 31.

Mosquito testing
Twenty-six local mosquito control agencies (Table 10) in California submitted a total of 145,338 mosquitoes (3501 pools) (Tables 11-12) to be tested for arboviruses at DARU. The test was an *in situ* enzyme immunoassay (EIA) using Vero cell culture. Sixty-seven pools of *Culex tarsalis* and three pools of *Culex quinquefasciatus* were positive for SLE (Table 13, and Figures 5-6), but none was positive for WEE. Nine pools of *Ochlerotatus melanimon* were positive for CE (Table 13 and Figure 5). All positive mosquito pools tested negative for WNV.

Chicken serosurveillance
Forty-nine local mosquito and vector control agencies maintained 194 sentinel chicken flocks (Table 10). Blood specimens from each flock were collected and tested biweekly. Chicken sera were screened using an EIA and confirmed with immunofluorescent antibody (IFA). A total of 20,087 chicken sera from 46 of the 49 agencies in California, and 750 sera from Nevada, Oregon, and Utah were tested for antibodies to SLE and WEE by VRDL.

A total of 62 seroconversions to SLE were recorded in sentinel chicken flocks in Imperial (11) and Riverside (51) counties (Table 14, and Figures 5 and 7). The first SLE seroconversions were detected in four chickens bled on June 18 in Riverside County. The last seroconversions were in Imperial County on September 5, 2001. Because chicken IgG antibody to SLE cross-reacts with WNV, a subsample of SLE-positive chickens, and specimens from other regions, were subsequently tested for WNV by DARU. None of the 69 sera from nine counties was positive for WNV. There were three seroconversions to WEE in Riverside County (Table 14).

Dead bird surveillance for West Nile virus
The dead bird surveillance program initiated in 2000 continued in 2001 and was supported through a CDC grant. Notifications were sent in March and August to approximately 600 agencies and groups explaining the program and requesting they contact DHS when dead birds, especially crows, were found. Recipients of the mailing included CDFA, DFG, USFWS, wildlife rehabilitation and refuge centers, National Audubon Society, local health departments, mosquito and vector control districts, veterinarians, animal control and environmental health officers. Necropsies of submitted carcasses were performed by CAHFS. Kidney, brain, and heart tissues were forwarded to DARU for testing via cell culture.

A total of 68 dead birds was reported to DHS from 19 counties: Butte, Contra Costa, Kern, Los Angeles, Marin, Mendocino, Monterey, Orange, Riverside, Sacramento, San Bernardino, San Diego, San Joaquin, San Luis Obispo, Shasta, Trinity, Tuolumne, Ventura, and Yolo. Eighteen birds met the criteria for testing; all specimens were negative for WNV.

Weekly arbovirus surveillance bulletin
DHS has historically published a weekly bulletin reporting arbovirus test results of humans, equines, mosquitoes, and sentinel chickens. In 2000, dead bird reports and other WNV surveillance information in California and throughout the United States were added to the weekly report. The bulletin provided weekly updates concerning the spread of WNV in the eastern half of the United States. The bulletin was distributed from May 4 to December 20 to local, state, and federal public health agencies, universities in California, and other state health departments.

California State Mosquito-Borne Virus Surveillance and Response Plan
The Response Plan, written by DHS in collaboration with the MVCAC and the University of California at Davis and Berkeley, was completed in 2001 and distributed to all local mosquito control agencies. The document describes an enhanced surveillance and response program for California to ensure that local and state agencies are prepared to detect and respond in a concerted effort to protect people and animals from mosquito-borne diseases. Unique to this document is the mosquito-borne virus risk assessment which delineates three levels of conditions and responses: normal season, emergency planning, and epidemic conditions.

West Nile virus in the United States
In 2001, WNV activity was reported in 27 states and the District of Columbia, including 16 states where the virus had not been detected previously. WNV expanded westward as far as western Arkansas. In 2001 there were 66 human cases (64 hospitalized) from 10 states with 9 fatalities (21 human cases with 2 fatalities were reported in 2000). Also in 2001, there were 731 equine cases from 19 states, 7114 infected dead birds from 27 states and the District of Columbia, and 919 positive mosquito pools (26 species) from 16 states and the District of Columbia. Florida, New York, and North Carolina reported seroconversions to WNV in sentinel chicken flocks.

Report prepared by Stan Husted, Vicki Kramer, Malcolm Thompson, Martin Castro, and Ashley Houchin

Table 10. Participation by local agencies in the mosquito-borne encephalitis surveillance program, 2001.

County	Agency[1]	Agency code	New Jersey Light Trap	Mosquito pools	No. flocks	No. chickens	No. sera samples tested
Alameda	Alameda Co. MAD	ALCO	X		3	19	273
Butte	Butte Co. MVCD	BUCO	X	X	7	91	1187
Colusa	Colusa MAD	CLSA	X		1	9	130
Contra Costa	Contra Costa MVCD	CNTR	X	X	3	30	390
Fresno	Consolidated MAD	CNSL	X		4	40	480
Fresno	Fresno MVCD	FRNO	X	X	2	20	260
Fresno	Fresno Westside MAD	FRWS	X	X	2	15	260
Glenn	Glenn Co. MVCD	GLEN	X	X	1	13	156
Imperial	Imperial Co. Environmental Health	IMPR			2	24	157
Inyo	Owens Valley MAP	OWVY	X		0		
Kern	Delano MAD	DLNO	X		2	20	200
Kern	Kern MVCD	KERN	X	X	9	90	1260
Kern	Westside MVCD	WEST	X		3	30	330
Kings	Kings MAD	KNGS	X	X	3	29	390
Lake	Lake Co. VCD	LAKE		X	2	19	200
Los Angeles	Antelope Valley MVCD	ANTV	X		5	35	455
Los Angeles	Greater Los Angeles Co. VCD	GRLA	X	X	4	38	666
Los Angeles	Long Beach Environmental Health	LONG		X	2	20	280
Los Angeles	Los Angeles Co. West VCD	LACW			18	99	432
Los Angeles	San Gabriel Valley MVCD	SGVA			10	60	820
Madera	Madera Co. MVCD	MADR	X	X	2	20	240
Marin/Sonoma	Marin-Sonoma MVCD	MARN	X		7	75	1078
Merced	Merced Co. MAD	MERC			6	36	390
Monterey	North Salinas MAD	NSAL	X		1	10	120
Napa	Napa MAD	NAPA	X		2	10	195
Orange	Orange Co. VCD	ORCO		X	1	7	170
Placer	Placer Co. VCD	PLCR	X	X	1	10	120
Riverside	Coachella Valley MVCD	COAV	X	X	9	90	1260
Riverside	Northwest MVCD	NWST	X	X	6	48	624
Riverside	Riverside Co. Environmental Health	RIVR	X		6	68	924
Sacramento/Yolo	Sacramento-Yolo MVCD	SAYO	X	X	9	80	1077
San Bernardino	San Bernardino Co. VCP	SANB	X	X	7	70	1050
San Bernardino	West Valley MVCD	WVAL			3	29	420
San Diego	San Diego Co. Dept of Health	SAND	X	X	3	30	520
San Joaquin	San Joaquin Co. MVCD	SJCM	X	X	3	36	630
San Mateo	San Mateo Co. MAD	SANM	X		2	20	390
Santa Barbara	Santa Barbara Coastal VCD	SBCO		X	4	36	300
Santa Clara	Santa Clara Co. VCD	STCL	X	X	2	19	260
Santa Cruz	Santa Cruz Co. MVCD	SCRZ	X		1	9	130
Shasta	Burney Basin MAD	BURN	X		2	17	200
Shasta	Shasta MVCD	SHAS	X	X	5	54	605
Solano	Solano Co. MAD	SOLA	X		2	21	264
Stanislaus	East Side MAD	EAST			1	11	140
Stanislaus	Turlock MAD	TRLK	X	X	4	47	528
Sutter/Yuba	Sutter-Yuba MVCD	SUYA	X	X	7	70	960
Tehama	Tehama Co. MVCD	TEHA	X		2	20	240
Tulare	Delta VCD	DLTA	X	X	6	62	780
Tulare	Tulare MAD	TRLE	X		2	20	260
Ventura	City of Moorpark	MOOR	X		1	10	150
Ventura	Ventura Co. Environmental Health	VENT	X	X	4	40	560
Total			**40**	**26**	**194**	**1776**	**22,911**

[1] MAD, Mosquito Abatement District; MAP, Mosquito Abatement Program; MVCD, Mosquito and Vector Control District; VCD, Vector Control District

Source: California Department of Health Services

Table 11. Mosquitoes (*Culex* spp. and *Ochlerotatus melanimon*) tested for WEE and SLE viruses by submitting county and agency, 2001.

		Cx pipiens		*Cx quinquefasciatus*		*Cx stigmatosoma*		*Cx tarsalis*		*Oc melanimon*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Butte	BUCO							9	464	6	307	15	**771**
Contra Costa	CNTR							235	11,701			235	**11,701**
Fresno	FRNO							16	679			16	**679**
Fresno	FRWS							12	549			12	**549**
Glenn	GLEN							27	1350			27	**1350**
Kern	KERN							335	9568	108	4620	443	**14,188**
Kings	KNGS							10	491			10	**491**
Lake	LAKE					11	406	117	5692	30	1418	158	**7516**
Los Angeles	GRLA			181	7,448			69	2852			250	**10,300**
Los Angeles	LONG			69	2,254			2	46			71	**2300**
Madera	MADR	9	450					1	50			10	**500**
Merced	TRLK							44	2160	5	250	49	**2410**
Orange	ORCO			73	1,937	1	11	31	918			105	**2866**
Placer	PLCR							8	348			8	**348**
Riverside	COAV			37	936			579	24,635			616	**25,571**
Riverside	NWST			184	8,155	69	2,416	39	1138			292	**11,709**
Sacramento	SAYO							294	13,272	174	7896	468	**21,168**
San Bernardino	SANB			15	377	7	132	25	992			47	**1501**
San Diego	SAND	1	19					2	98			3	**117**
San Joaquin	SJCM	29	945					43	1563	10	236	82	**2744**
Santa Barbara	SBCO			25	1,001	4	119	47	2216			76	**3336**
Santa Clara	STCL							2	90			2	**90**
Shasta	SHAS							22	1044			22	**1044**
Stanislaus	TRLK							44	2019	1	50	45	**2069**
Sutter	SUYA							106	4924	3	125	109	**5049**
Tulare	DLTA							29	1285			29	**1285**
Ventura	VENT							15	750			15	**750**
Yolo	SAYO							193	9192	16	694	209	**9886**
Yuba	SUYA							12	528			12	**528**
Grand Total		**39**	**1414**	**584**	**22,108**	**92**	**3084**	**2368**	**100,614**	**353**	**15,596**	**3436**	**142,816**

Table 12. Other mosquito species tested for WEE and SLE viruses by submitting county and agency, 2001.

		An franciscanus		*An hermsi*		*Oc taeniorhynchus*		*Oc washinoi*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Riverside	NWST			1	20					1	**20**
Santa Barbara	SBCO	1	20	19	790	5	250	11	430	36	**1490**
Grand Total		**1**	**20**	**20**	**810**	**5**	**250**	**11**	**430**	**37**	**1510**

		Cs incidens		*Cs inornata*		*Cx erythrothorax*		*Cq perturbans*		Total	
County	Agency	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.	pools	mosqs.
Sacramento	SAYO			1	2					1	**2**
San Bernardino	SANB					1	12			1	**12**
San Joaquin	SJCM					4	94			4	**94**
Santa Barbara	SBCO	3	49	2	21	16	784			21	**854**
Shasta	SHAS							1	50	1	**50**
Grand Total		**3**	**49**	**3**	**23**	**21**	**890**	**1**	**50**	**28**	**1012**

Source: California Department of Health Services

Table 13. SLE snd CE viral isolates from mosquito pools during 2001.

Mosquito species	Dates collected	County	Agency	Virus isolated					
				SLE		CE		Totals	
				Pools	Mosquitoes	Pools	Mosquitoes	Pools	Mosquitoes
Culex tarsalis	6/13-7/5	Riverside	COAV	43	2179	-	-	43	2179
	7/10-8/02	Riverside	COAV	21	895	-	-	21	895
	9/4	Riverside	COAV	1	10	-	-	1	10
	7/10-7/11	Riverside	COAV	2	75	-	-	2	75
Culex quinquefasciatus	9/4	Riverside	COAV	1	21	-	-	1	21
	7/24-8/02	Riverside	COAV	2	74	-	-	2	74
	6/22	Kern	KERN	-	-	3	130	3	130
Ochlerotatus melanimon	5/26 – 6/8	Kern	KERN	-	-	5	242	5	242
	9/14	Sacramento	SAYO	-	-	1	14	1	14
Totals				**70**	**3180**	**9**	**386**	**79**	**3566**

Table 14. Chicken seroconversions to SLE and WEE (data in italics) by location and date bled, 2001.

County	Agency	City	18-Jun	2-Jul	16-Jul	30-Jul	2-Aug	7-Aug	16-Aug	13-Aug	27-Aug	5-Sep	**Total**
Imperial	IMPR	El Centro						1				4	**5**
Imperial	IMPR	Seeley						2				4	**6**
Riverside	COAV	Blythe					*1*		*2*				***3***
Riverside	COAV	Thermal				1							**1**
Riverside	COAV	Oasis			1	2							**3**
Riverside	COAV	Mecca (A)	4	4	2	1					1		**12**
Riverside	COAV	North Shore (D)			5					1	1		**7**
Riverside	COAV	Mecca (G)		5	4	1							**10**
Riverside	COAV	Mecca (M)		1	8	1				1	2		**13**
Riverside	COAV	North Shore (SP)			4								**4**
Riverside	COAV	Indio								1			**1**
SLE Totals			**4**	**10**	**24**	**6**		**3**		**3**	**4**	**8**	**62**
WEE Totals							***1***		***2***				***3***

Source: California Department of Health Services

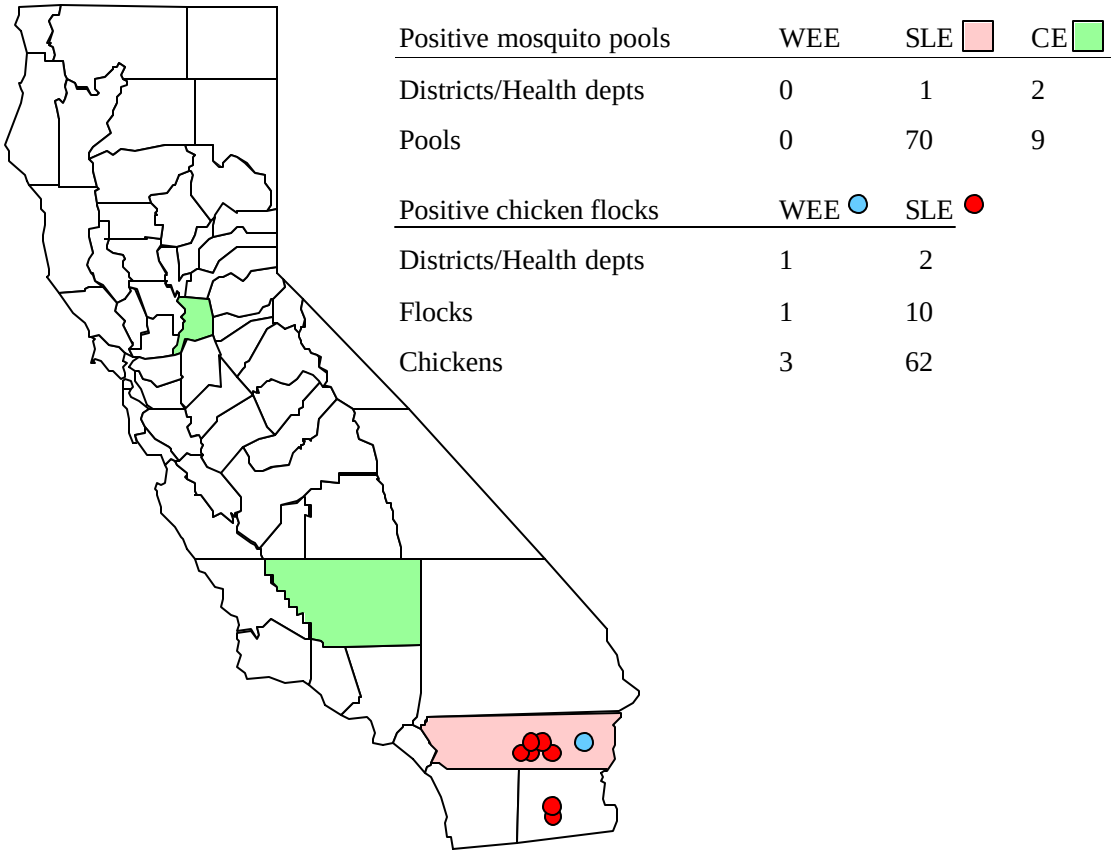


Figure 5. Location of mosquito pools in California which were positive for SLE or CE, and sentinel chicken flocks with at least one seroconversion to SLE or WEE, California, 2001.

Source: California Department of Health Services

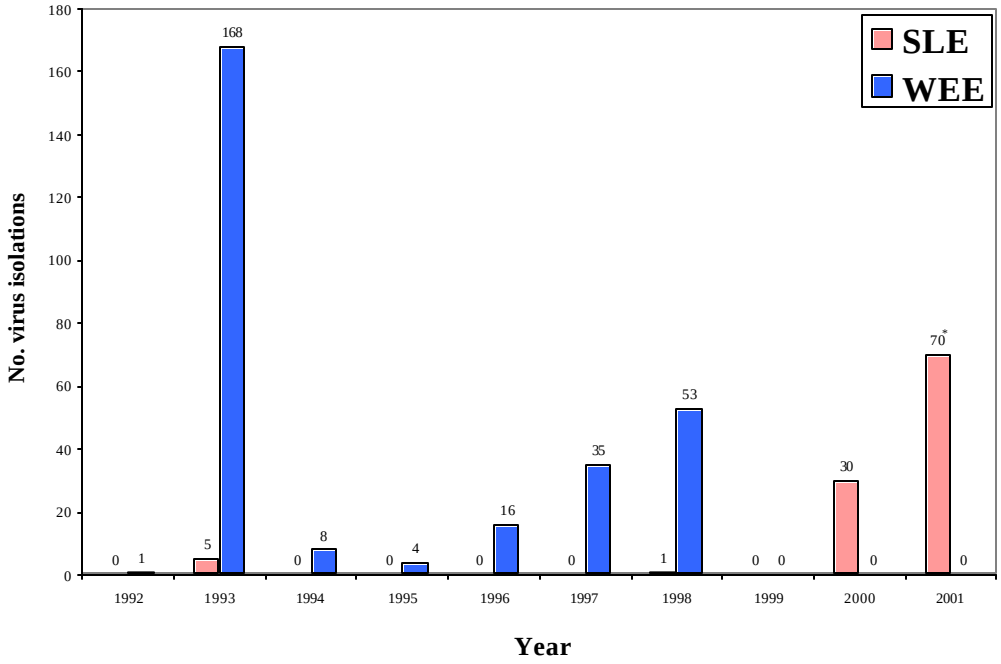


Figure 6. Isolations of SLE and WEE viruses from pooled *Culex tarsalis* in California, 1992-2001. *This includes three positive pools of *Culex quinquefasciatus* in 2001.

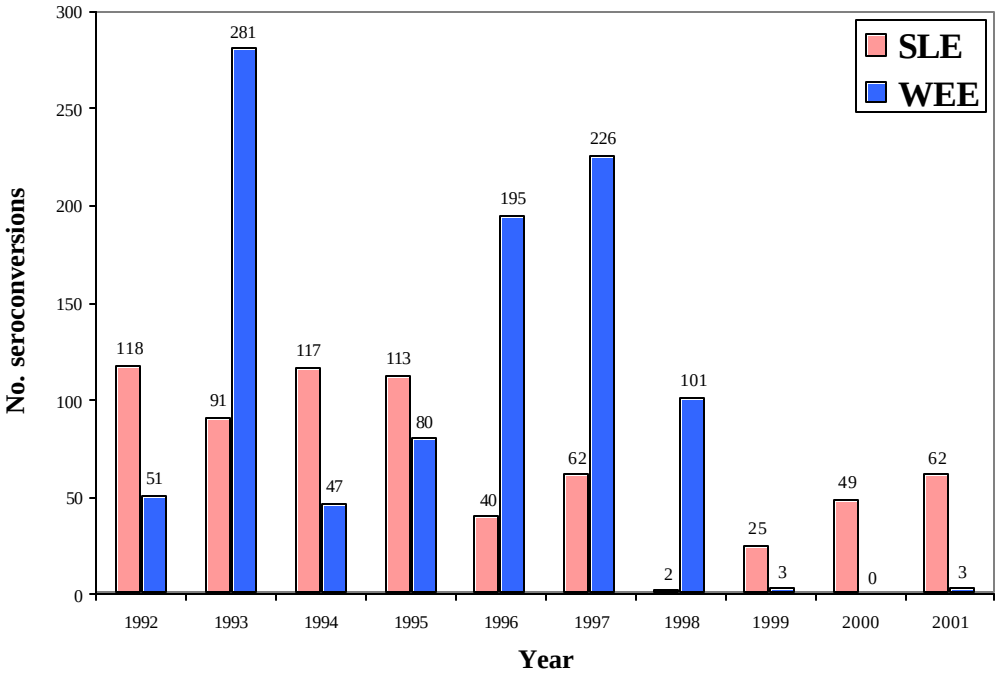


Figure 7. Seroconversions to SLE and WEE viruses in sentinel chicken flocks in California, 1992-2001.

Source: California Department of Health Services

Aedes albopictus Infestations in California

Aedes albopictus is a very aggressive biter and a known vector of dengue virus in Southeast Asia, Southern China, Japan, and the Seychelles, second in importance only to *Ae. aegypti.* As a maintenance vector and occasionally as an epidemic vector, it is responsible for many thousands of human cases of dengue, dengue hemorrhagic fever, and dengue shock syndrome in Asia. Dengue virus can infect *Ae. albopictus* oviducts and be transmitted to its eggs. This leads to inefficient but effective transovarial transmission of the virus. Dengue is hyperendemic in Southeast Asia and transmission is currently at an extremely elevated level. *Aedes albopictus* is also a potential vector of yellow fever, LaCrosse encephalitis, dog heartworm, and other diseases in this country.

Aedes (Stegomyia) albopictus (Skuse) was detected in June 2001 at the ports of Los Angeles and Long Beach and subsequently in at least 14 wholesale/secondary distributor plant nurseries in California. This exotic mosquito was imported from China in shipments of *Dracaena* species sold as "Lucky Bamboo." Historically, this ornamental plant was imported to the United States from China and other Asian countries in dry containers via airfreight. However, due to increased demand for this product, in approximately January 2000 shipments began to arrive in via cargo ships. To keep the plants green during this ocean journey, the plants were shipped in 2-3 inches of water, thereby providing habitat for mosquito larvae. This was only the third time that *Ae. albopictus* has been found in California. It was previously found in tires in Oakland in 1971 and again in Oakland in the 1980s, but both infestations were very small in terms of numbers of mosquitoes and distribution compared to the 2001 infestations.

Aedes albopictus was initially discovered in a cargo container by a USDA/APHIS Plant Protection and Quarantine Officer, Centers for Disease Control and Prevention (CDC) Quarantine Officers, and personnel from the Greater Los Angeles County Vector Control District (VCD). Subsequent investigations at wholesale nurseries by local mosquito and vector control agencies and county health departments documented additional infestations at 14 locations in Los Angeles (7), Orange (2), San Bernardino (2), San Diego (1), San Joaquin (1), and Santa Clara (1) counties (Table 15, Figure 8). Intensive vector control operations were conducted at all infestation sites. On June 29, the CDC imposed an embargo of shipments of *Dracaena* in standing water, permitting shipments arriving before July 17 to be treated.

Mosquitoes from two sites were trapped and tested for the presence of viral pathogens. Seven and fourteen *Ae. albopictus* submitted from Santa Clara County VCD and San Joaquin County Mosquitio and Vector Control District (MVCD), respectively, were tested for dengue, Saint Louis encephalitis, Murray Valley, and Japanese encephalitis; all were negative.

Local mosquito and vector control districts, county public health agencies, and the Vector-Borne Disease Section (VBDS) expanded surveillance activities in and around all wholesale nurseries involved in *Dracaena* spp. distribution to determine whether other nurseries were infested, and to determine if the infestation had spread outside of the nurseries. At two nurseries in Los Angeles County, adult mosquito activity was detected into November, more than five months after the initial detection. Surveillance will continue at all infestation sites in 2002 to determine whether *Ae. albopictus* persisted through the winter months.

In 2001, VBDS recommended that the following activities be conducted to contain and/or eradicate *Ae. albopictus*: (1) apply adulticides to plant holding areas, and sustained release methoprene to water in plant holding containers where *Ae. albopictus* is detected; (2) continue to monitor adult populations after insecticide treatments to assure that the population of *Ae. albopictus* is eradicated at the nursery; (3) monitor *Ae. albopictus* populations around the periphery of infested sites and in the vicinity of the site, utilizing oviposition traps or other appropriate surveillance methods to determine if populations have been established outside the borders of the nursery; (4) continue spot monitoring of infestation sites as future shipments are received; and (5) train warehouse staff on methods to reduce infestation risk (e.g., maintaining water levels to prevent repeated drying and reflooding of *Ae. albopictus* eggs should they be present).

Although there is an embargo on *Dracaena* shipments in standing water, the moist stalks of the plants may serve as a substrate for oviposition. Therefore, in collaboration with the CDC, VBDS developed recommendations for the processing and shipment of *Dracaena* species by exporters in Asia. Recommendations were designed to reduce the risk of further introductions of *Ae. albopictus* in dry shipments sent to California. Recommendations included insuring that all steps in the processing of *Dracaena* shipments, from the time plant stalks are first placed in water until the time the plants are placed in maritime containers at the port, are conducted in mosquito-free facilities. These facilities should have screens and doors that close automatically. Mosquito adulticides should be applied regularly as space sprays in the facility to kill any mosquitoes that may enter. Additionally, to control any adult mosquitoes that may be present, a residual insecticide treatment should be administered to each individual box containing *Dracaena* just before being packed into the maritime shipment container and sealed. VBDS encouraged vector control districts and local health departments to share these recommendations with wholesale importers of *Dracaena* within their respective jurisdictions and exporters in Asia.

Report prepared by Ken Linthicum and Vicki Kramer

Table 15. Chronology of the discovery of *Aedes albopictus* in California in 2001.[1]

Date	Infestation number	Location	Agencies involved[2]	Findings/Actions[3]
June 14, 15	First discovery in maritime container	Los Angeles Harbor	USDA/APHIS, CDC, GLACVCD, UCR	Adults collected, identified
June 20	Second discovery in maritime container	Long Beach L.A. County	GLACVCD, UCR, USDA/APHIS	Larvae collected, containers adulticided
June 22, 23	1	Rowland Heights L.A. County	GLACVCD, DHS	Adults feeding, larvae collected
June 27	2	Monterey Park L.A. County	San Gabriel Valley MVCD, DHS	Adults feeding
June 29, July 2	3	San Martin Santa Clara County		Larvae and adults collected
July 3	4	Alhambra L.A. County	San Gabriel Valley MVCD	Adults collected
July 6	5	Chino San Bernardino County	West Valley MVCD	Larvae and adults collected
July 6	6	Chinatown L.A. County	GLACVCD	Larvae and pupae collected
July 9	7	Chino San Bernardino County	West Valley MVCD	Adults collected
July 12	8, 9	Brea, Westminster Orange County	Orange County VCD	Adults collected
July 17	10	Vista San Diego County	San Diego VSP	Larvae collected, plant water drained. August 7 adults collected
July 19	11/1	South San Francisco San Mateo County	San Mateo County MAD, DHS	Pupa collected at USDA inspection site
July 20	11/2	Lodi San Joaquin County	San Joaquin County MVCD, DHS	Larvae, pupae and adults collected
July 23	12	City of Industry L.A. County	San Gabriel Valley MVCD	Larvae collected, plant water drained
August 13	13,14	El Monte L.A. County	San Gabriel Valley MVCD	Adults collected, plant water drained

[1] No *Aedes albopictus* infestations were detected by agencies conducting surveillance in the following counties: Alameda, Contra Costa, Fresno, Lake, Riverside, Sacramento, San Francisco, Santa Cruz, Solano, and Yolo.

[2] APHIS, Animal & Plant Health Inspection Service; CDC, Centers for Disease Control and Prevention; GLACVCD, Greater Los Angeles County Vector Control District; DHS, California Department of Health Services; L.A. County; Los Angeles County; MVCD, Mosquito and Vector Control District.

[3] Extensive larviciding and/or adulticiding was done at all sites.

Source: California Department of Health Services

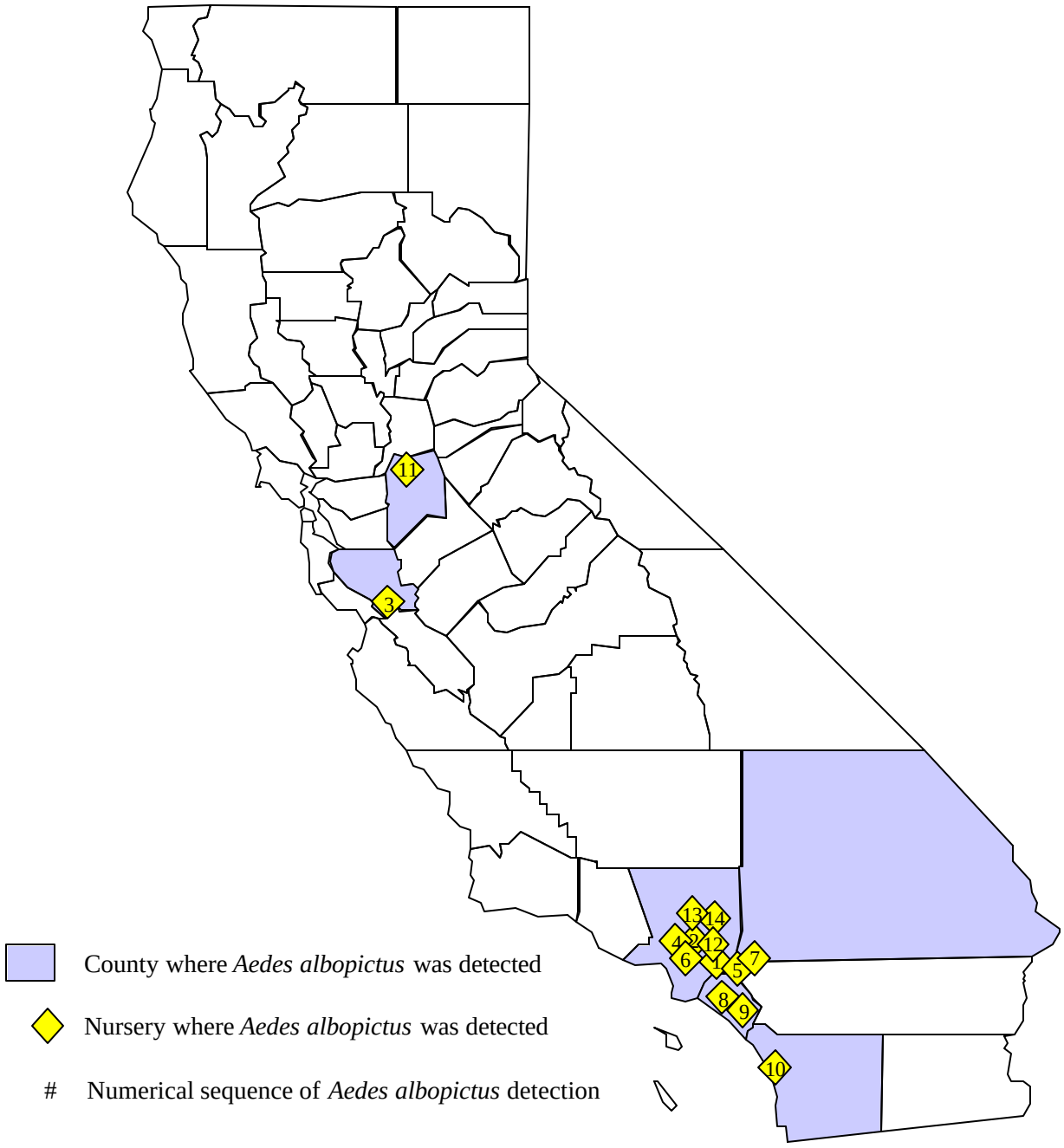


Figure 8. Location by county where *Aedes albopictus* infestations were discovered in California in 2001.

Source: California Department of Health Services

Caltrans Special Project: Mosquito Production

Introduction and background

In 1997, the California Department of Transportation (Caltrans) initiated a Best Management Practice (BMP) Retrofit Pilot Program for treating stormwater runoff from its facilities in Los Angeles and San Diego Counties. The objective of this program was to evaluate the installation and operation, as well as relative benefits and costs, of various structural "treatment" BMP devices for improving water quality. Caltrans retrofit 39 BMPs at 33 strategically selected study sites (e.g., freeway interchanges, park & rides, and maintenance stations) using 8 different designs.

Concern was raised that treatment BMP installations such as those implemented by Caltrans could potentially impact public health by increasing habitat availability for aquatic stages of disease vectors, particularly mosquitoes. The California Department of Health Services (DHS) entered into a Memorandum of Understanding with Caltrans in 1999 to provide technical expertise regarding vector production and the potential of vector-borne diseases within its stormwater BMP Retrofit Pilot Program. It was the intent of this agreement to document and, where possible, mitigate vector production and harborage at the BMP pilot project sites. The DHS Vector-Borne Disease Section (VBDS) established a comprehensive vector surveillance and monitoring program, developed vector abatement protocols, and recommended design modifications to reduce or eliminate the potential of BMPs to produce or harbor vectors. VBDS also identified which BMPs were least conducive to vector production.

Mosquito surveillance and control

In May 1999, VBDS initiated a two-year comprehensive vector surveillance and monitoring plan for the Caltrans BMP Retrofit Pilot Program. Collaborating local vector control agencies (Greater Los Angeles County Vector Control District, San Gabriel Valley Mosquito and Vector Control District, Los Angeles County West Vector Control District, and San Diego County Vector Surveillance and Control) monitored all BMP study sites weekly for immature stages of mosquitoes. VBDS staff conducted simultaneous evaluations of vegetative cover, predators of immature mosquitoes, physical and chemical properties of water, and evidence of rodent and other vector populations.

The initial two-year vector surveillance plan concluded in April 2001. Mosquitoes were the dominant vector species observed within BMP structures. Eight mosquito species were collected from standing water in BMPs, four that are known vectors of human disease such as viral encephalitis and malaria. These species included *Culex stigmatosoma*, *Cx. tarsalis*, *Cx. quinquefasciatus*, *Culiseta incidens*, *Cs. inornata*, *Anopheles hermsi*, *An. franciscanus*, and *Ochlerotatus* (*Aedes*) *squamiger*.

Of the eight different types of BMPs, those that maintained permanent sources of standing water in sumps or basins provided excellent habitat for immature mosquitoes. Multi-Chambered Treatment Trains (MCTT) and Continuous Deflective Separator (CDS) units supported the largest populations of mosquitoes relative to other designs. In contrast, those BMPs designed to drain rapidly, such as extended detention basins and infiltration devices, provided fewer suitable habitats and harbored mosquitoes less frequently. Only three BMP types harbored no mosquito larvae at any point during the two-year study (Figure 9).

Design recommendations for mosquito suppression

BMPs that held standing water for over 72 hours were carefully examined to determine how to minimize or eliminate mosquito production without impairing the intended water quality benefits and function of the structures. VBDS, Caltrans, stormwater consultants, and collaborating vector control agencies successfully developed and implemented changes to BMP designs. For example, the installation of gasketed aluminum covers over the sedimentation basins of MCTTs successfully excluded egg-laying mosquitoes from accessing the permanent water contained within them. CDS devices were similarly mosquito-proofed using tight-sealing foam gaskets around the perimeter of sump access covers and a collapsible net bag around the outlet pipe, another access point to the permanent water sump. In surveillance conducted in 2001, mosquitoes were not observed to breed in the modified MCTT and CDS devices. VBDS is continuing to monitor these, and other mosquito-proofed BMPs, to evaluate the efficacy and longevity of the modifications.

Out-of-state investigations

As stormwater runoff is a relatively new and rapidly growing field of interest in the United States, VBDS solicited information in 2000 from nearly 300 vector control agencies nationwide to better understand the vector problems and solutions associated with stormwater management structures. This study revealed that vector production noted within Caltrans BMPs was not unique to Southern California. In 2001, VBDS gathered additional information from eight selected states. In addition to the information requested in the questionnaire, VBDS interviewed key personnel by telephone. Information was collected from over 45 agencies, including vector control agencies, state and local departments of health and transportation, and municipalities. In addition, VBDS toured treatment BMPs in Portland, Oregon, and Austin, Texas, to observe vector habitats created by these structures. This exercise underscored the need for continued cooperation and communication between the numerous governmental agencies that are involved in stormwater runoff management.

Summary of VBDS activities in 2001

- Regularly inspected Caltrans BMPs for areas of standing water, as well as for design and maintenance flaws that had the potential to create future breeding habitats.
- Presented Caltrans with formal recommendations for preventing vector breeding habitats in certain BMP designs, based on field observations and review of design plans.
- Continued collaboration with local vector control agencies conducting vector surveillance of BMPs.
- Maintained database of immature mosquito abundance data collected from standing water in BMPs by collaborating vector control agencies.
- Presented findings of the Caltrans special project at professional meetings, continuing education seminars, and informal meetings. In particular, VBDS stressed the importance of minimizing or eliminating vector habitat through BMP design.
- Prepared a memorandum to Caltrans regarding the importance of access to BMP structures to allow for proper vector surveillance and abatement. In particular, VBDS stressed the need for perimeter roads around larger structures wide enough to accommodate work vehicles.
- Provided Caltrans with information regarding the legal authority of DHS and local districts (mosquito abatement, vector control, and pest abatement) to conduct vector control in California. VBDS emphasized specific sections of the California Health and Safety Code, particularly those that describe the control procedures of vectors, those that define any source of standing water as a potential public nuisance, and those that describe civil penalties.

- Reviewed design plans for several new treatment BMPs and provided Caltrans with comments regarding their potential to harbor vectors.
- Prepared extensive written reports that 1) summarized mosquito production in Caltrans treatment BMPs during the two-year study, 2) provided recommendations for preventing or minimizing mosquito habitat in treatment BMPs, and 3) evaluated the results of the nationwide BMP/vector survey study.

Report prepared by Marco Metzger and Charles Myers

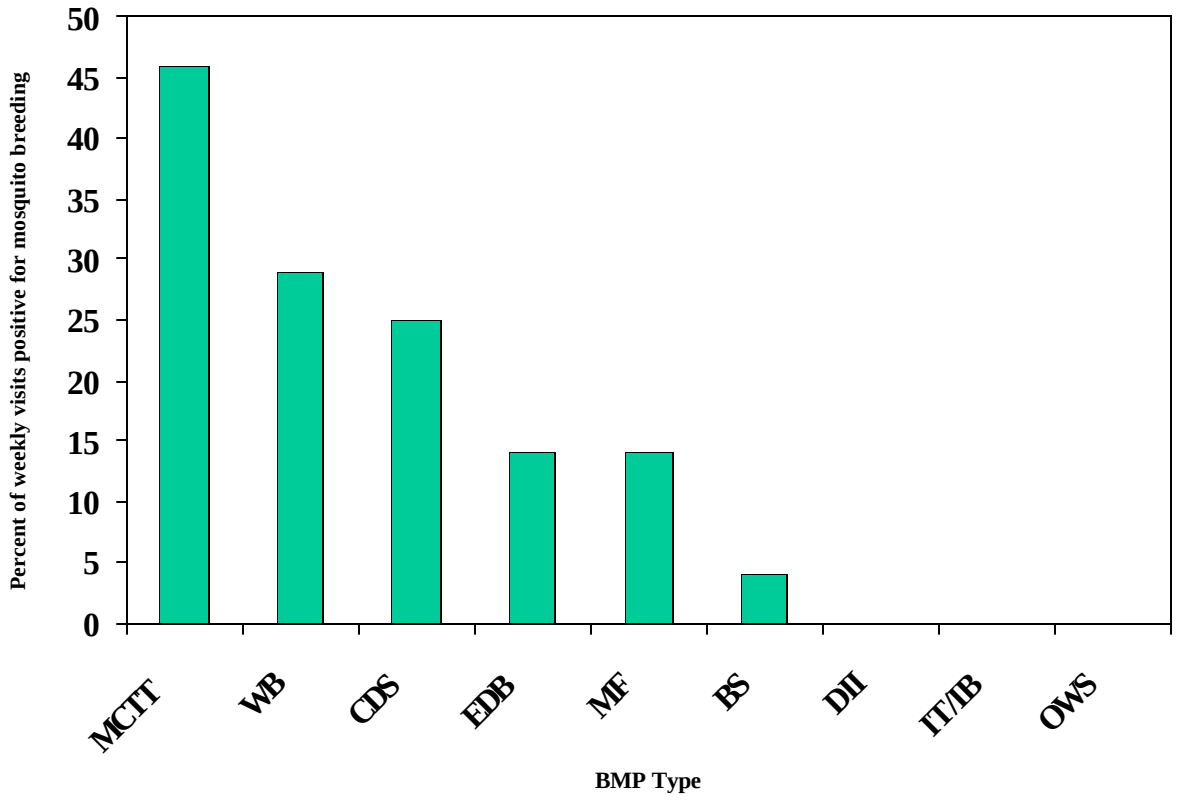


Figure 9. Weekly mosquito monitoring in Caltrans BMP structures (May 1999-April 2001).

Abbreviations:

BS, Biological Filtration Swale/Strip
CDS, Continuous Deflective Separator
DII, Drain Inlet Insert
EDB, Extended Detention Basin
IT/IB, Infiltration Trench/Infiltration Basin
MCTT, Multi-Chambered Treatment Train
MF, Media Filter
OWS, Oil-Water Separator
WB, Wet Basin

Source: California Department of Health Services

United States Forest Service Activities

In 1992, the Vector-Borne Disease Section (VBDS) entered into a Challenge Cost-Share Agreement with the Pacific Southwest Region of the United States Department of Agriculture Forest Service to maintain cooperative surveillance and control of vector-borne diseases within the National Forests. The United States Forest Service (USFS) and VBDS established this agreement to achieve mutually beneficial objectives in pest control and management, mandated by both federal and state law. VBDS and the USFS agreed to work cooperatively in planning and implementing vector-borne disease management programs.

In accordance with this agreement, VBDS staff conducted field activities in the following National Forests in 2001: Angeles, Cleveland, Eldorado, Humboldt-Toiyabe, Inyo, Klamath, Lake Tahoe Basin Management, Lassen, Los Padres, Mendocino, Modoc, Plumas, San Bernardino, Sequoia, Shasta-Trinity, Sierra, Six Rivers, Stanislaus, and Tahoe. In addition, VBDS provided consultation, certification, and oversight to autonomous agencies (environmental health departments and vector control agencies) concerning vector-borne diseases and pesticide applications for public health purposes on USFS land.

Activities conducted by VBDS staff in National Forests included disease surveillance, risk assessment, risk reduction, and education of USFS personnel and concessionaires. Among these activities was an investigation of seven human cases of tick-borne relapsing fever that were acquired on or near USFS land. Direct surveillance included the collection and testing of indicator species and vectors for plague, hantavirus, arenavirus, Lyme disease, and other tick-borne diseases (Table 16); and indirect surveillance included visual assessment of vector-borne disease risk factors (e.g., counting active rodents and evaluating rodent burrows for abandonment). Based on surveillance information, risk reduction recommendations for vector-borne diseases were made for recreational areas, fire lookouts, employee residences, and work places. Recommendations included control of vectors, rodent management, and habitat modification. Training in pesticide safety was provided for USFS personnel or other groups who participated in vector suppression activities. Follow-up evaluations were made to determine whether vector numbers had been adequately reduced. Educational activities involved providing information on specimen collection and identification, vector-borne disease epidemiology, and methods to reduce risk of infection. Posters and brochures on plague, hantavirus, and Lyme disease were distributed to ranger district offices, USFS concessionaires, and individual campgrounds in regions endemic for these diseases. This report includes detailed information on vector-borne disease activities in individual National Forests in 2001.

Table 16. Laboratory testing of specimens collected on USFS lands, 2001.
(No. specimens positive / No. specimens tested)

National Forest	Hantavirus surveillance (rodents)		Plague surveillance (rodents)		Plague surveillance (carnivores)[1]		Borrelia surveillance (*Ixodes* ticks)[2]		Other pathogen surveillance (other ticks)[3]
	No. tested	No. positive	No. tested	No. positive	No. tested	No. positive	No. tested	No. positive	No. positive
Angeles	7	0	215[4]	0	15	0	499	0	
Cleveland	10	0			16	0	248	0	
Eldorado					62	3			
Humboldt-Toiyabe	21	2	22	1					
Inyo			77	3			15	0	58
Lake Tahoe Basin			29	10	5	2			
Los Padres			95	3	48	4	301	5	5
Mendocino					29	0			
Modoc	6	0	6	0	30	5			
Plumas	86	4			10	2			
San Bernardino	251	0	305	0	29	4	409	2	
Sequoia			65	0	12	2			
Shasta-Trinity					6	0	132	1	
Sierra					9	0			
Tahoe					29	1			
Total, all Forests	**381**	**6**	**814**	**17**	**300**	**23**	**1604**	**8**	**63**

[1] Carnivore specimens taken directly from or immediately adjacent to USFS lands. Because of the broad home range of carnivores, results obtained can be inferred to a large area, including both USFS and adjacent lands. Many of these specimens were collected by USDA Animal Wildlife Services through a contractual agreement with the California Department of Health Services.

[2] *Ixodes pacificus* ticks tested for infection with *Borrelia* and *Ehrlichia* spp. bacteria. Ticks were tested in collaboration with the US Army Center for Health Promotion and Preventive Medicine (USACHPPM), the University of California, and the Washoe County.

[3] *Dermacentor occidentalis* ticks tested for infection with *Bartonella* spp. bacteria. Results are pending.

[4] Testing conducted by the Los Angeles County Department of Health Services.

Source: California Department of Health Services

ACTIVITY SUMMARY BY INDIVIDUAL NATIONAL FORESTS

Angeles National Forest

- Collaborated with the Los Angeles County Department of Health Services (LACDHS) and the U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) to test western black-legged ticks (*Ixodes pacificus*) from various National Forest locations for evidence of infection with bacteria in the genus *Borrelia* (including the causative agent of Lyme disease) or *Ehrlichia* (including the causative agent of human ehrlichioses). None of 499 *I. pacificus* ticks collected and tested was infected.
- Evaluated tick habitats at various sites near Manker Flats campground. No sites appeared to be suitable tick habitat.
- Surveyed the Mt. Baldy area for suitable tick habitats. No sites appeared to be suitable tick habitat.
- Conducted tick surveillance at Sycamore Flat campground. No ticks were collected.
- Collaborated with the San Bernardino County Vector Control Program (VCP) to conduct hantavirus surveillance near Lytle Creek. None of seven rodents submitted for testing were infected with hantavirus.
- Collaborated with the LACDHS to conduct plague surveillance at Table Mountain campground. Rodents were tested for infection with plague bacteria at the Los Angeles County DHS Laboratory. None of 13 ground squirrels tested had antibodies to plague.
- Under a cooperative agreement between DHS and LACDHS, plague surveillance and application of Diazinon 2D insecticidal dust for flea control was conducted by the LACDHS and the Los Angeles County Agricultural Commissioner at various campgrounds and picnic areas within the National Forest. In total, 1162 lbs of Diazinon 2D dust was applied at campgrounds and picnic areas throughout the National Forest. None of 202 rodents captured and tested had antibodies to plague.

Cleveland National Forest

- Collaborated with the Riverside County Environmental Health Department (EHD) and the USCHPPM to test *I. pacificus* ticks for evidence of infection with *Borrelia* or *Ehrlichia* spp. bacteria. Ticks were collected in the Ortega Mountains and along the Santa Rosa Plateau. None of the 248 ticks tested was infected.
- Collaborated with the Northwest Mosquito Abatement District, the Riverside County EHD, and the San Diego County EHD to test rodents for evidence of hantavirus infection. There was no evidence of hantavirus infection in the 10 rodents tested.
- Visually surveyed rodent activity at Blue Jay, El Cariso, Falcon Group, Upper San Juan, Wildomar, Dripping Springs, and Oak Grove campgrounds. Rodent activity at these campgrounds was low to moderate.
- Discussed vector-borne disease epidemiology with personnel at the National Forest Headquarters in Rancho Bernardo, as well as the Palomar and Trabulo Ranger District Offices. Provided safety, fire, and recreation officers with educational literature on vector-borne diseases in the National Forest.
- Presented educational seminars on vector-borne diseases endemic to National Forests in California at the annual Forest Insect and Pathogen Conference.
- Presented educational seminars on vector-borne diseases to USFS personnel at the Temescal Fire Station.

Eldorado National Forest

- Conducted tick surveillance at several sites in Alpine County during May. There were no *Ixodes* ticks found.
- Consulted with USFS personnel at the USFS nursery in Placerville on measures to exclude and mitigate rodent infestation of workspace. Conducted surveillance to identify rodent activity in and near nursery buildings. Discussed survey results with USFS nursery personnel and presented information on vector-borne diseases in California.
- Evaluated rodent activity at Ice House, Northwind, Strawberry Point, Jones Fork, Fashoda, Sunset, Wench Creek, Yellowjacket, South Fork, Gerle Creek, North Shore, and Wolf Creek campgrounds. Ice House campground had high numbers of ground squirrels while the remaining campgrounds had low to moderate rodent activity.
- Evaluated rodent activity at Lumberyard, Pardoes Point, Silver Lake, and Sugar Pine Point campgrounds. Plague risk was discussed with ranger district representatives and concessionaires, and plague caution signs were posted.

Humboldt-Toiyabe National Forest

- Conducted tick surveillance at six sites in Alpine County during early January. No ticks were found.
- Collaborated with the U.S. Navy Disease Vector Ecology and Control Center to conduct surveillance for hantavirus and plague at the U.S. Marine Corps Mountain Warfare Training Center near Bridgeport. Rodent sera and tissue samples were tested by the Centers for Disease Control and Prevention (CDC) for evidence of infection with plague bacteria and hantavirus. In all, 53 rodents were captured of which two of 21 deer mice (*Peromyscus maniculatus*) from the Silver Creek area had antibodies to hantavirus and one of 22 chipmunks (*Tamias speciosus*) from near Leavitt Meadows campground had antibodies to plague.
- Evaluated rodent activity at Hope Valley, Kit Carson, and Silver Creek campgrounds. Rodent abundance was moderate at all locations. Plague caution signs were posted at each campground.

Inyo National Forest

- Conducted tick surveillance for *Borrelia burgdorferi* at Lewis Canyon, Sageflat Canyon, and Cottonwood Canyon near Lone Pine, at Horseshoe Canyon near Mammoth Lakes, and on USFS land near Lee Vining. During these surveys, 15 *I. pacificus* and 58 *Dermacentor occidentalis* ticks were collected. None of the *I. pacificus* ticks collected and tested in collaboration with the University of California was infected with *B. burgdorferi*. The area near Lone Pine remains of interest due to the identification in 1999 by VBDS biologists and University of California researchers of a *Borrelia* sp. genetically distinct from *B. burgdorferi* which infects rodents in this area. The *D. occidentalis* ticks will be tested in collaboration with the University of California for evidence of infection with *Bartonella* spp. bacteria.
- Collaborated with Inyo NF personnel to investigate a cluster of relapsing fever cases at the USFS Crestview Fire Station near Mammoth Lakes. Trapping at the Fire Station yielded a number of rodents that may carry this bacterial pathogen, however no soft tick vectors were collected. It remains unknown whether persons infected acquired the disease at the Fire Station or at a nearby outdoor work site where they were conducting research.

- Conducted tick surveillance at Red Meadows campground. No ticks were collected.
- Conducted a rodent survey to evaluate hantavirus risk at Lee Vining Ranger Station. Human-rodent contact was estimated to be moderate to high and improvements to rodent proofing of buildings were recommended.
- Conducted plague surveillance in collaboration with Inyo County Environmental Health Department and Mono County Department of Environmental Health (DEH) at Four Jeffrey, Oh Ridge, Convict Lake, East Fork, and French Camp campgrounds. One of 21 ground squirrels captured at Four Jeffrey campground had antibodies to plague. A single chipmunk was also captured but did not have antibodies to plague. Flea control was conducted at this site using 27 lbs of Diazinon 2D insecticidal dust. This site will be evaluated in spring of 2002 to determine if further control efforts will be needed.
- Conducted plague surveillance at Sherwin Creek. None of the rodents captured (six ground squirrels and one chipmunk) had antibodies to plague.
- Collaborated with the Mono County DEH to conduct plague surveillance and rodent control at Crestview Fire Station, and the nearby Upper and Lower Deadman campgrounds. One of 24 chipmunks and none of seven ground squirrels had antibodies to plague. Evaluated the effectiveness of flea control through the use of rodent bait stations containing Diazinon 2D insecticidal dust at Crestview Fire Station. Following application of the insecticidal dust, the flea index (number of fleas per rodent) dropped from 1.2 to 0.37 and none of eight chipmunks captured had antibodies to plague. Upper and Lower Deadman campgrounds were also treated with Diazinon 2D insecticidal dust to reduce flea numbers. In total, 18.5 lbs of Diazinon 2D dust were applied to the campgrounds and fire station.
- Collaborated with the Mono County DEH to conduct plague surveillance and rodent control at Big Springs campground. One of seven ground squirrels and none of two chipmunks had antibodies to plague. Flea control was conducted at Big Springs Campground using 5 lbs of Diazinon 2D insecticidal dust placed into rodent burrows. This site will be evaluated in spring of 2002 to determine if further control efforts are needed.
- Visually surveyed rodent activity at Old and New Shady Rest, and Glass Creek campgrounds, where plague has historically been active. Rodent populations appeared low at these sites.

Klamath National Forest

- Surveyed Juanita Lake campground for rodent activity. Although the number of plague susceptible rodents appeared low, the campground was posted with a plague caution sign due to historical evidence of plague in this area.

Lake Tahoe Basin Management

- Collaborated with the El Dorado County EHD to conduct investigation of possible plague epizootic at Tallac Visitor Center in South Lake Tahoe. Ten of 29 rodents tested had antibodies to plague. In addition, one of nine pools of fleas collected from yellow-pine chipmunks was infected with plague bacteria indicating that active plague transmission was occurring at this site. Due to surveillance results, flea control using Diazinon 2D dust was initiated at Tallac Visitor Center and the Valhalla Recreation Area. El Dorado County EHD and USFS personnel were provided training by VBDS personnel and assisted in the flea control effort. In total, 100 lbs of Diazinon 2D dust were applied to approximately 15 acres at the Visitor Center.

- Evaluated rodent activity at Camp Richardson Resort. Rodent activity was low to moderate. The resort contracts for rodent management from a private company.

Lassen National Forest

- Evaluated hantavirus risk at Butte Meadows and Mineral Fire Stations. Discussed findings with USFS fire management personnel. Provided rodent exclusion options to Mineral Fire Station personnel.
- Visually inspected West Branch, Butte Meadows, and Cherry Hill campgrounds for rodent activity. Very few rodents were observed at these sites, however due to past plague activity in this area all campgrounds were posted with plague caution signs.
- Surveyed rodent activity at Hat Creek District campgrounds (Cave, Rocky, Bridge, and Hat Creek campgrounds). Found high numbers of ground squirrels at all campgrounds. Contacted Hat Creek Ranger District office as well as camp hosts to discuss findings. Posted plague warning signs at all campgrounds.
- Surveyed Mill Creek, Hole-in-the-ground, Potato Patch, Elam, and Alder Creek campgrounds in the Almanor and Eagle Lake Ranger Districts for rodent activity. Plague caution signs were posted due to the historical presence of plague in this region.
- Conducted visual surveillance for rodent activity at Battle Creek, Gurnsey Creek, Almanor, and Benner Creek campgrounds. Numerous ground squirrels were noted at Battle Creek while Gurnsey Creek supported a larger numbers of chipmunks. All campgrounds were posted with plague warning signs.
- Contacted Hat Creek, Almanor, and Eagle Lake Ranger Districts to discuss vector-borne disease issues. Provided recommendations and literature to districts on the epidemiology of Lyme disease, hantavirus, and plague.

Los Padres National Forest

- Conducted tick-borne disease surveillance at Arroyo Seco campground and along the Arroyo Seco trail. Of 279 *I. pacificus* ticks collected, 157 were tested for infection with *Borrelia* or *Ehrlichia* spp. An additional 44 ticks were tested for infection with specifically *B. burgdorferi*. None of the ticks tested were infected with *B. burgdorferi* or any *Ehrlichia* spp., however two pools of 10 ticks were found to be infected with a *Borrelia* sp. genetically distinct from *B. burgdorferi*. Brush mice (*Peromyscus boylii*) were collected and tested for the presence of anti-*Borrelia* antibodies. These results are still pending. Additionally, five *D. occidentalis* ticks were collected from this site and will be tested for evidence of infection with *Bartonella* bacteria.
- Conducted tick-borne disease surveillance at Cerro Alto campground. Three of 10 pools (10 ticks per pool) of *I. pacificus* ticks collected were infected with an unknown *Borrelia.*
- Visually surveyed Arroyo Seco campground for evidence of rodent activity.
- Continued plague epidemiology and control studies at Chuchupate campground. During 2001, 46 rodents were collected of which three had antibodies to plague. The three rodents with plague antibodies were likely infected during a previous year as rodent flea numbers remained at very low levels throughout 2001. As part of this study, 20 flea species were collected and identified from rodents captured at this site, including numerous new species records. Fourteen of these flea species may be involved in plague transmission. Results of these studies were presented at the Entomological Society of America annual meeting.
- Conducted plague surveillance at Upper Oso campground. None of 11 rodents captured had plague antibodies.

- Conducted plague surveillance at Mt. Pinos campground. None of ten rodents captured had plague antibodies.
- Conducted plague surveillance at Paradise campground. None of 17 rodents captured had plague antibodies.
- Collaborated with Kern County EHD to conduct plague surveillance at McGill campground. None of ten ground squirrels and one chipmunk captured had antibodies to plague. Literature was provided to the camp hosts and plague caution signs were posted at McGill campground due to the presence of moderate numbers of rodents and a history of plague transmission at this site. (Plague-infected rodents were captured at McGill during 2000.)
- Surveyed Camp Alto, Paradise, Upper Oso, Red Rock, Sage Hill, and Valle Vista campgrounds, and Lower Oso, Falls, and Live Oak day use areas for rodent activity.
- Provided consultation on insect and leech identification to the Santa Maria District Office.
- Provided educational presentation to a recreational group—"Back Country Horsemen of the Los Padres NF"—on tick-borne disease epidemiology and risk reduction.

Mendocino National Forest

- Evaluated hantavirus risk at Cold Springs Fire Station. Buildings appeared to be clean and not likely to be infested by rodents. Findings were discussed with District Ranger.
- Conducted walk-through inspection of Log Springs Fire Station for hantavirus risk. Some rodent activity was noted near USFS buildings. Discussed findings with personnel at Corning Ranger District and suggested that firewood be stored away from buildings to reduce rodent harborage near buildings.
- Visually inspected campgrounds surrounding Lake Pillsbury (Sunset, Oakflat, Fuller Grove, Pogie Point, and Navy Camp campgrounds) for rodent activity. Navy Camp campground was closed, while the remaining campgrounds had low to moderate rodent populations. Rodent populations at these sites were greater than during the previous four years.
- Visually inspected Toomes Camp, Rocky Cabin, and Williams campgrounds for rodent activity. Rodent activity appeared to be low at each of these campgrounds.

Modoc National Forest

- Conducted tick surveillance at several locations in the Big Valley area in response to citizen concerns about Lyme disease. No *Ixodes* and only a few *Dermacentor* ticks were collected during late winter and early spring sampling.
- Conducted surveillance for hantavirus and plague at Long Bell Fire Guard Station and Round Mountain Fire Lookout. None of six deer mice were infected with hantavirus and none of six chipmunks had antibodies to plague. In addition, facilities were inspected for rodent presence. Recent rodent proofing conducted at these facilities has been very effective at limiting rodent access. Long Bell Fire Station has also contracted with a local pest control company giving this facility an additional level of protection from rodent-borne diseases.
- Contacted Big Valley and Devils Garden Ranger Districts to discuss hantavirus risk reduction when opening seasonal use fire stations and fire lookouts.
- Evaluated rodent densities at Cedar Pass, Blue Lake, Mill Creek Falls, and Stough Reservoir campgrounds. Numbers of rodents were determined to be low at all

campgrounds. Campgrounds were posted with plague caution signs and campground hosts were provided with plague and hantavirus literature.

- Visually inspected campgrounds in the North Warner District for rodent activity. Inspected Lily Lake, Cave Lake, and Larry Flat campgrounds. Few rodents were noted at these sites; however all were posted with plague caution signs. Discussed plague and hantavirus precautions with USFS District personnel.
- Contacted Cedarville Ranger District to discuss vector-borne disease issues. Provided literature on the epidemiology of Lyme disease, hantavirus, and plague. Also provided plague caution signs for posting at campgrounds and USFS day use areas.

Plumas National Forest

- Continued long-term hantavirus project at Laufman Fire Station. Rodent surveillance was conducted four times in 2001. Of 86 total rodents captured, four were infected with hantavirus, including one western harvest mouse (*Reithrodontomys megalotis*). This is the second infected western harvest mouse captured during this project. It was noted that more mice were captured in or near facility buildings in June than during trapping periods in September, December, or April. It was also noted that fewer rodent numbers were captured in September compared to other trapping periods. USFS personnel and the Province Safety Officer were notified of the findings. This project will continue over the next several years to better understand the ecology of hantavirus in California and the associated human risk.
- Discussed hantavirus risk and methods for risk reduction at seasonal use fire management facilities with USFS personnel from Mt. Hough, Beckwourth, and Oroville Ranger Districts. Conducted an inspection of Mohawk Fire Station and Range Management storage facilities. Both sites appeared to have low rodent activity.
- Surveyed Buck Lake, Lake Davis, and Antelope Lake areas for rodent activity. Sites inspected were Mill Creek, Sundew, Lower Bucks, Grizzly Creek, Grizzly, Grasshopper, Lightening Tree, Boulder Creek, Long Point, and Lone Rock campgrounds. All campgrounds were posted with plague warning signs due to the historical presence of plague in the area.
- Contacted Oroville and Mohawk Ranger Districts to discuss vector-borne disease issues. Inspected storage facilities for presence of deer mice. Posted plague caution signs at Gasner Bar, Queen Lily, and North Fork campgrounds due to historical presence of plague in this area.

San Bernardino National Forest

- Collaborated with the Riverside County EHD, the San Bernardino County VCP, and USCHPPM to test *I. pacificus* ticks for evidence of infection with *Borrelia* and *Ehrlichia* spp. bacteria. Ticks were collected from Cranston Station, Gardner Valley, and Silent Valley areas. Evidence of *Borrelia* sp. was detected by polymerase chain reaction in two of 409 ticks collected. Both infected ticks were collected from the Gardner Valley area.
- Surveyed Morton Point for ticks. No *Ixodes* ticks were collected at this site.
- Tested rodents for evidence of hantavirus infection from campgrounds and trailheads throughout the National Forest in collaboration with the LACDHS, the San Bernardino County VCP, and the Riverside County EHD. None of the 251 rodents tested was infected.
- Evaluated hantavirus risk at Vista Grande Fire Station in the San Jacinto Ranger District. Discussed findings and recommendations with Fire Captain and District Supervisor.

- Tested rodents for evidence of plague from campgrounds and trailheads throughout the National Forest in collaboration with the LACDHS, the San Bernardino County VCP, and the Riverside County EHD. Plague was not detected in any of the 305 rodents tested.
- Provided an educational presentation on vector-borne diseases on USFS lands to fire and off highway vehicle volunteers at Del Rosa Fire Station. Discussed risks and methods of risk reduction for plague, hantavirus, Lyme disease, and relapsing fever.

Sequoia National Forest

- Conducted plague surveillance at Tillie Creek, Paradise Cove, and Headquarters campgrounds. Ground squirrel activity and flea indices were high to very high at each of these campgrounds. None of the 65 ground squirrels tested had antibodies to plague. Nevertheless, as plague has been historically transmitted in this area, plague caution signs were posted at these campgrounds and campground hosts were provided educational literature. The remaining campgrounds surrounding Lake Isabella (Main Dam, French Gulch, Boulder Gulch, Hungry Gulch, Live Oak, Sandy Flat, and Camp 3) as well as Coral Creek Picnic Area were visually surveyed for rodent activity. Rodent numbers were low to moderate.
- Visually surveyed campgrounds in Hume Lake Ranger District for rodent activity. Survey included Hume Lake, Landslide, Princess, and Grant Grove campgrounds. Rodent activity was moderate at Hume Lake campground and plague epidemiology was discussed with campground concessionaires at this site. Rodent activity appeared low at the remaining campgrounds.
- Visually surveyed campgrounds in the Tule River Ranger District for rodent activity. Rodent activity was moderate at Coffee Creek and Camp Wishon campgrounds, and plague caution signs were posted at these sites due to the historical presence of plague. Rodent numbers appeared low at all other campgrounds north and west of Johnsondale (Coffee Creek, Coy Flat, Belknap, Quaking Aspen, Upper and Lower Peppermint, Long Meadow, Redwood Meadow, Holey Meadow, Camps 1-6 (north of Johnsondale)). Rodent activity was low to moderate at all campgrounds between Johnsondale and Lake Isabella (Limestone, Fairview, Gold Ledge, Hospital Flat, Camp 3, Headquarters, and Camp 9). Plague caution signs were posted at these campgrounds due to the historical presence of plague on the Kern Plateau and in the Kern River valley. Vector-borne disease epidemiology was discussed with campground hosts and USFS district personnel. Educational literature was also provided.
- Provided an educational presentation covering vector-borne diseases on USFS lands to California Land Management employees (USFS campground concessionaires) during their annual pre-season meeting. Discussed methods of risk reduction for plague, hantavirus, Lyme disease, and relapsing fever.

Shasta-Trinity National Forest

- Sampled ticks in the vicinity of Hirtz Bay, Dekkas Rock, Moore Creek areas and at Ellery Creek, Pine Point, and McCloud Bridge campgrounds along the McCloud River. This survey was part of an ongoing *Ixodes* surveillance program in the northern forests. Ticks were collected at Hirtz Bay, Dekkas Rock, Moore Creek and at McCloud Bridge campground. Ticks were tested for infection in collaboration with Washoe County (Nevada) Vector Control. One of 62 ticks was infected with *B. burgdorferi*. The infected tick was collected at Dekkas Rock campground.

- Surveyed tick population at Lake Shasta area campgrounds during May. Very few adult ticks were present. No ticks were retained for testing.
- Conducted tick surveillance along Portem Creek Falls Trail and Fenders Ferry Dam. None of 70 *I. pacificus* ticks collected was infected with *Borrelia* or *Ehrlichia* spp. bacteria.
- Conducted hantavirus risk assessment at Knob Peak Fire Lookout. No evidence of rodent infestation was seen due to recent cleaning and on-going renovation. Contacted Platina Ranger District Fire Management personnel to discuss assessment results. Risk assessment will be conducted again when renovation is completed.
- Evaluated Ash Creek Fire Station for hantavirus risk. Discussed results with USFS fire personnel and district personnel at McCloud Ranger Station. Provided USFS personnel with educational brochures and discussed methods of rodent-proofing facilities and proper handling of dead rodents.
- Visually inspected Ah Di Nah and Cow Camp campgrounds for evidence of rodent activity. Some ground squirrels were present. Findings were discussed with USFS personnel at McCloud Ranger District.
- Conducted visual plague surveillance at Fowlers campground and Middle Falls picnic area. These sites were recently renovated to facilitate increased public use. Ground squirrels and chipmunks were present at these sites; increased human activity could lead to greater risk of human-rodent contact.
- Contacted the Fire Management Officer at the Shasta Lake Ranger District to discuss hantavirus and Lyme disease epidemiology.

Sierra National Forest

- Conducted tick surveillance along Way of the Mono Nature Trail (west side of Bass Lake) and along USFS road 65/24. Four *I. pacificus* were collected along the nature trail, but snow cover limited tick activity. These ticks were not tested for infection.
- Visually surveyed Camp 4, Camp 4 ½, Mill Creek, and Kirch Flat campgrounds for rodent activity. There were low numbers of ground squirrels and chipmunks at these sites. These campgrounds did not look well-used by the public, but use may increase during the rafting season due to their location along the upper Kings River east of Lake Trimmer.
- Conducted visual surveillance for rodent activity at Chilkoot, Soquel, Fresno Dome, Big Sandy, Grey Mountain, Lower Chiquito, Placer, Sweet Water, and Mammoth Pool campgrounds. Rodent abundance appeared moderate at Fresno Dome and Mammoth Pool and low at the remaining campgrounds. Plague caution signs were posted and educational brochures were left with campground hosts. Provided USFS personnel at Minarets Work Station and Visitor Center with educational brochures on vector-borne diseases.
- Visually surveyed Forks, Lupine-Cedar Bluff, Spring Cove, and Wishon Point campgrounds to evaluate rodent activity. Rodent abundance appeared low. Due to the historical presence of plague in this area, plague caution signs were posted and educational brochures were left with campground hosts. USFS personnel at North Fork Ranger Station and Bass Lake Campground Registration were also provided educational brochures discussing vector-borne diseases.
- Discussed vector-borne disease epidemiology and risk factors with the Safety Officer and biologists of the Pacific Gas and Electric (PG&E) power facility on the Kings River. PG&E employees live and maintain their electric lines on USFS lands, and thus are

subject to infection with tick and rodent-borne diseases. Provided educational literature to Safety Officer for dissemination to PG&E employees.

Six Rivers National Forest

- Conducted tick surveillance at Big Flat, Grassy Flat, and Botanical Site. Very few *Ixodes* ticks were found at this time (April).

Stanislaus National Forest

- Conducted tick surveillance at several sites in Alpine County during May. No *Ixodes* ticks were found at any of these sites.
- Conducted tick surveillance in the vicinities of Fence Creek, Boulder Flat, and Clark Fork campgrounds. No *I. pacificus* ticks were collected at these sites.
- Conducted tick surveillance along Hwy 4 from USFS land to Big Trees State Park. No ticks were found, however this was likely due to the very wet conditions at the time of collection.
- Surveyed and evaluated rodent activity at Baker, Brightman Flat, Cascade Creek, Dardenelle, Eureka Valley, Fence Creek, Fraser Flat, Mill Creek, Niagara Creek, Pigeon Flat, and Boulder Flat campgrounds. Educational materials were left with USFS personnel at Brightman Station, Summit, and Mi Wuk Ranger Stations.
- Evaluated rodent activity at Bloomfield, Highland Lakes, Hermit Valley, Pacific Valley, Mosquito Lakes, Silver Valley, Pine Marten, Lake Alpine, Lodgepole and Lodgepole Overflow campgrounds. Rodent abundance appeared moderate at Mosquito Lakes, Highland Lakes, and Pine Marten and low at the remaining campgrounds. Plague caution signs were posted and educational brochures were left with the campground hosts.
- Visually surveyed rodent activity at Wakalu Hep Yo, Big Meadow, Stanislaus River, and Spicer Reservoir campgrounds. Rodent abundance appeared low. Due to the historical presence of plague in this area, plague caution signs were posted and educational brochures were left with campground hosts. Educational brochures were also left with USFS personnel at Hathaway Pines Ranger Station.

Tahoe National Forest

- Conducted visual plague surveillance at Goose Meadows, Granite Flat, and Silver Creek campgrounds. Ground squirrel populations were moderate to high. Due to the historical presence of plague in this area, campgrounds were posted with plague caution signs and educational literature was provided to campground hosts and USFS personnel.
- Surveyed campgrounds in the Sierra Buttes region for rodent activity. Sites surveyed included: Berger Creek, Diablo, Sardine Lake, Salmon Creek, Packer Lake, Chapman Creek, Packsaddle, and Yuba Pass campgrounds. All sites were posted with plague caution signs due to historical presence of plague in this area. Contacts were made at the Sierraville Ranger District to discuss vector-borne diseases and methods of risk reduction.
- Surveyed rodent activity at campgrounds near Truckee: Giant Gap, Shirttail, Morning Star, Sugar Pine, Forbes Group Camp, Boca, Prosser, Lake Side, Boca Rest, Boca Springs, Boyington Hill, Logger, Upper Little Truckee, and Lower Little Truckee campgrounds. The Forest Genetic Center and Big Bend Visitor Center were also surveyed.

OTHER SERVICES PROVIDED:

- Initiated a multi-agency tick surveillance study to better understand the ecology of *I. pacificus* ticks in southern California. This research project is being conducted in collaboration with the Los Angeles County Department of Health Services, Riverside County EHD, San Bernardino County VCP, and Los Angeles West Vector Control District. The goals are to learn more about the prevalence and seasonal activity of adult, nymphal, and larval stage *Ixodes* ticks, and to better understand the seasonal transmission risk of *Borrelioses* to humans in southern California.
- Wrote report "Summary of Hantavirus Pulmonary Syndrome Rodent Surveillance in U.S. National Forests in California: 1993-1999" which described the association of rodent species, habitat, and elevation with the prevalence of hantavirus infection on USFS land.
- Continued dialogue with the Food and Drug Center for Veterinary Medicine, the California Department of Fish and Game, and a private rodenticide bait manufacturer regarding the use of Lufenuron® (a chitin synthesis inhibitor pesticide) in rodent feed cubes to reduce flea numbers on treated rodents. These feed cubes have been shown in previous studies by VBDS to reduce flea numbers and plague occurrence at a USFS campground.
- Completed a manuscript on the use of modified, host-targeted bait tubes and liquid deltamethrin for flea control on ground squirrels and chipmunks. This manuscript will be published in the Journal of Vector Ecology.
- A by-forest historical listing of animals infected with plague was provided to each VBDS biologist and to the USFS liaison.
- Developed and taught a rodent identification program to assist other biologists and interested parties in the identification of rodent species that may play a role in the transmission of human disease on USFS land.
- Compiled digital image reference library of USFS campgrounds to identify ecological associations between habitat and presence of vector species.
- Participated in the ten-year Forest Plan Update meetings held at various locations in Southern California. This update was for the Angeles, Cleveland, Los Padres, and San Bernardino National Forests. The need for a proactive plan to reduce vector-borne disease transmission on USFS lands was brought forward.
- Provided training in vector-borne disease epidemiology and vector control to USFS personnel, county environmental health departments, and vector control districts that work on USFS lands. Training is provided through annual workshops, special seminars and presentations, and field demonstrations.
- Compiled a by-forest contact list of USFS biologists, district rangers, fire management officers, recreation officers, and safety officers. This contact list will assist VBDS biologists to communicate investigation and surveillance findings to appropriate USFS personnel and will also help to ensure that all areas of the USFS in California are receiving service by VBDS.
- Compiled a contact list for USFS Region five campground concessionaire companies. This contact list will enable VBDS biologists to contact campground hosts to discuss vector-borne diseases. This contact list will also assist VBDS in the investigation of human disease cases where the site of infection was thought to be a USFS campground.

Report prepared by Alec Gerry and Vicki Kramer

Head Lice Prevention and Control Program

In 1999, the Vector-Borne Disease Section (VBDS) reestablished a lead role for the California Department of Health Services (DHS) in the statewide prevention of head lice. Guidelines for prevention and control were developed for school districts and parents, incorporating information and suggestions from many local health departments, school districts, university researchers, the California Department of Education, and the Department of Social Services (responsible for licensing day care centers). In 2000, VBDS continued to promote head lice prevention through wide distribution of the guidelines, publication of prevention and control recommendations in the California Medical Association newsletter, and presentation of numerous seminars to agencies and organizations throughout the state.

In 2001, VBDS continued to serve as a central source for head lice prevention information in California. VBDS staff provided more than 400 head lice consultations to local agencies. A full-time seasonal biologist was hired to oversee the head lice program.

The "Guidelines on Head Lice Control for School Districts and Child Care Facilities" and the "Guidelines for Parents to Control Head Lice" were revised in 2001 to reflect recent developments in research. Revisions included providing (1) a definition of a chronic head lice case and treatment recommendations for such cases, (2) emphasis that transmission is more likely to occur in the home environment than at school, and (3) current information on prescription products for head lice control. The revised guidelines were distributed to the Directors of Public Health Nursing and other local personnel responsible for head lice control in each county. In August, one-page versions of the guidelines were included in information packets sent by the DHS Immunizations Branch to 8000 day care centers, preschools, and elementary schools. In October, DHS issued a press release to inform the general public about the need for head lice prevention in school children.

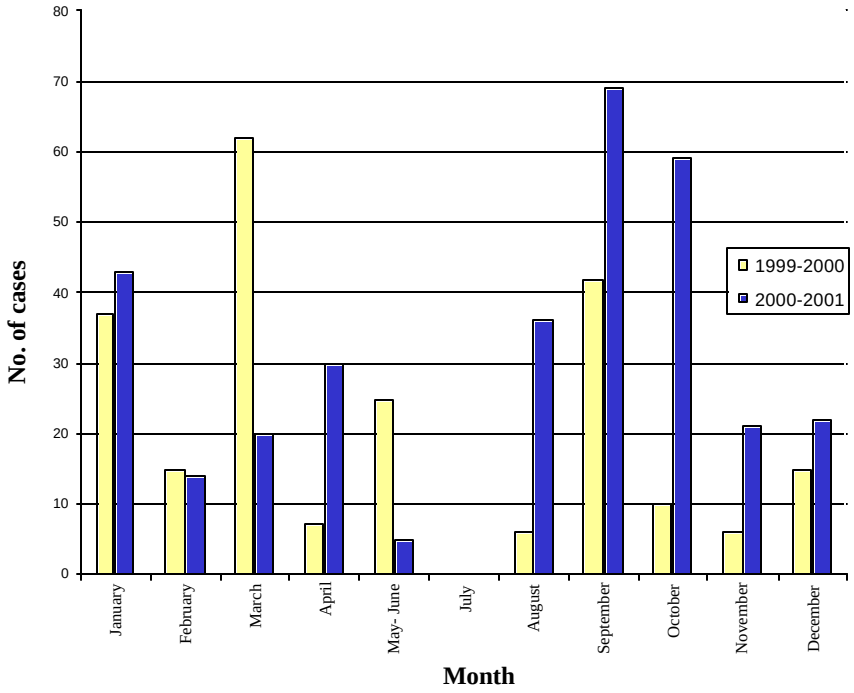
VBDS created an interactive tutorial based on the guidelines and distributed it to local health departments and other interested parties. A packet containing the guidelines, key references for the tutorial, and a list of designated staff to handle head lice calls for each health department were mailed to all the health departments in California. The guidelines were also made available on the DHS Web site.

As of January 2002, lindane-containing products such as Kwell® will be prohibited from sale in California for treatment of head lice and scabies. Following discussions between VBDS and Medi-Cal, Ovide® (0.5% malathion) was placed on the Medi-Cal formulary, providing physicians an alternative to Kwell®. VBDS responded to inquiries from physicians regarding the use of Ovide® in severe head lice infestations encountered in homeless individuals.

Data on head lice cases and school absences in California have historically been very difficult to obtain as pediculosis is not a reportable disease. In 2001, DHS began to collect head lice case counts from two rural counties that conduct surveillance (Figure 10). In one county (County A), head lice case reports increased slightly from 225 (60 cases per 1000 students) in 1999-2000 to 319 (65 cases per 1000 students) in 2000-2001. The observed increase in reported cases was likely due to improved reporting efficiency during the 2000-2001 school year rather than an actual increase in case numbers. An estimated 775 school days were lost due to head lice in the

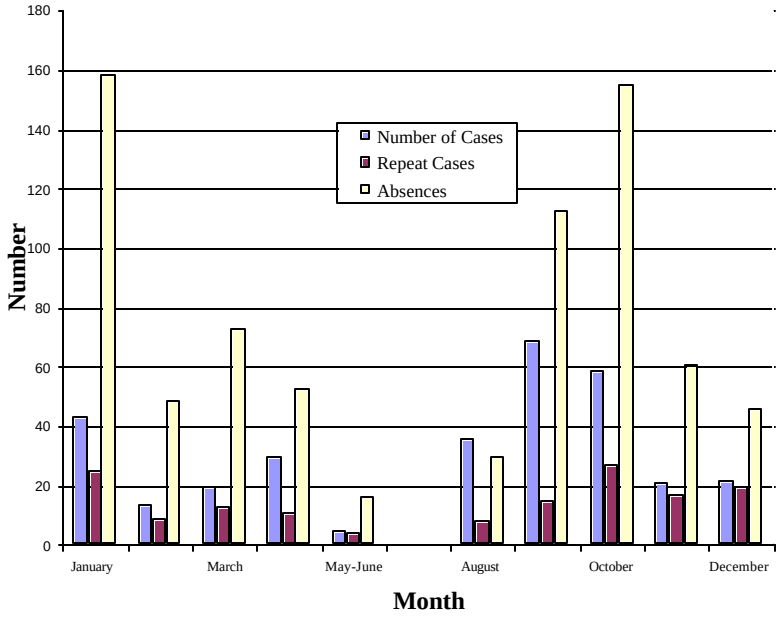
county in 2000-2001 (Figure 11). In the second county (County B), two elementary schools reported 153 cases, 37 repeat cases, and 486 missed school days in 2000-2001 due to head lice. Data from these two counties and anecdotal information from other counties indicate that head lice continues to be a serious public health issue that likely contributes to the loss of thousands of school days in California each year.

Report prepared by Stan Husted and Denise Steinlein



**May and June were combined due to the reduced number of days school was in session during June.

Figure 10. Reported head lice cases in a rural California county (County A), 1999-2000 (enrollment 3779), 2000-2001 (enrollment 4927).



**May and June were combined due to the reduced number of days school was in session during June.

Figure 11. Reported head lice cases, repeat cases, and absences due to head lice by month in a rural California county (County A), 2000-2001 (enrollment 4927).

Source: California Department of Health Services

Vector Control Technician Certification Program

The California Department of Health Services (DHS) administers the Public Health Vector Control Technician certification examination in May and November each year. The purpose of this examination is to certify the competence of government agency personnel in the control of vectors for the health and safety of the public. Authority to administer this exam is found in Health and Safety Code, Section 106925, which requires every government agency employee who handles, applies, or supervises the use of any pesticide for public health purposes to be certified by DHS. Standards governing certification of local agency vector control personnel are found in Title 17 of the California Code of Regulations, Sections 30001-30061. The first DHS-sponsored certification examination to qualify agency personnel in Mosquito Control was held in April 1974.

To become certified in a control category, applicants must pass the Core section and at least one Specialty section of the examination. The Core section consists of questions on the safe and effective use of pesticides. Specialty sections contain questions on the control of relevant vectors of the other exam sections listed in Table 17. Successful examinees electing to participate in continuing education are issued a gold certification card, which is valid for two years in the qualified categories specified on the card. To maintain their full certification status in subsequent two-year cycles, Certified Technicians are required to pay annual renewal fees and meet minimum continuing education requirements. Successful examinees electing not to participate in continuing education are issued parchment certificates in the categories in which they qualified. These Certified Technicians (Limited) employees may not use pesticides except under the direct supervision of a Certified Technician.

At year's end, 1095 vector control technicians employed at 102 local public health agencies held 2472 certificates (Table 18). The local agencies include 52 mosquito abatement districts, mosquito and/or vector control districts and other special districts, 36 departments of county government, 13 departments of city government, and the Vector-Borne Disease Section of DHS.

Report prepared by Malcolm Thompson

Table 17. Results of certification examinations administered in 2001.

Exam section	No. exams given	No. passed (%)
Core	151	116 (76.8)
Mosquito Control	137	87 (63.5)
Terrestrial Invertebrate Vector Control	149	90 (60.4)
Vertebrate Vector Control	131	108 (82.4)
TOTALS	568	401 (70.6)

Table 18. Vector control technician certificates in effect as of December 2001.

	No. certificates		
Certification category	**Full status**	**Limited status**	**Sum**
Mosquito Control	653	186	839
Terrestrial Invertebrate Vector Control	552	209	761
Vertebrate Vector Control	573	299	872
TOTALS	1778	694	2472

Source: California Department of Health Services

Staff Presentations and Publications

Presentations

JANUARY

- **Field Efficacy of Aqua-Reslin**
  Mosquito and Vector Control Association of California (MVCAC) Annual Conference Napa: *Mark Novak*
- **Field Evaluation of Aqua-Pyrenone and Pyrenone Against Aedes nigromaculis in Merced County**
  MVCAC Annual Conference, Napa: *Mark Novak*
- **Mosquito-borne Virus Surveillance and Response Plan**
  MVCAC Annual Conference, Napa: *Vicki Kramer*
- **Occupational Exposure to Rodent-borne Viruses: Are You at Risk?**
  MVCAC Annual Conference, Napa: *Curtis Fritz*
- **Stormwater, Pollution, BMPs and Vectors. An Update of DHS Activities in Southern California**
  MVCAC Annual Conference, Napa: *Marco Metzger*
- **Surveillance for Mosquito-Borne Encephalitis Virus Activity and Human Disease in California, Including West Nile Virus, 2000**
  MVCAC Annual Conference, Napa: *Stan Husted*
- **Vector-borne Diseases in California: 2000 in Review**
  MVCAC Annual Conference, Napa: *Vicki Kramer*
- **Vector-borne Diseases in California**
  Sacramento National Wildlife Complex, Willows: *Ken Townzen*

FEBRUARY

- **Borrelia burgdorferi Vaccine: A Shot in the Arm for Lyme Disease Prevention?**
  The Wildlife Society, Western Section, Annual Conference, Sacramento: *Curtis Fritz*
- **Lyme Disease in California and the Lyme Disease Advisory Committee**
  The Wildlife Society, Western Section, Annual Conference, Sacramento: *Anne Kjemtrup*
- **Ehrlichiosis in California**
  DHS/MVCAC Tick-Borne Diseases Workshop, Santa Fe Springs and Vacaville *Marty Castro*
- **Hantavirus Update in California**
  MVCAC Coastal Region Continuing Education Workshop, San Ramon: *Lucia Hui*
- **Human Babesiosis in California**
  DHS/MVCAC Tick-borne Diseases Workshop, Santa Fe Springs and Vacaville *Anne Kjemtrup*
- **The Lyme Disease Advisory Committee**
  DHS/MVCAC Tick-borne Diseases Workshop, Santa Fe Springs and Vacaville *Vicki Kramer*
- **Lyme Disease Ecology in California**
  DHS/MVCAC Tick-borne Diseases Workshop, Santa Fe Springs and Vacaville *Lucia Hui*

- **Lyme Disease: Epidemiology, Diagnosis, Treatment, and Prevention**
  DHS/MVCAC Tick-borne Diseases Workshop, Santa Fe Springs and Vacaville
  Curtis Fritz
- **Malaria: A Review and Update**
  MVCAC Coastal Region Continuing Education Workshop, San Ramon: *Mark Novak*
- **Mosquito Production in Stormwater Treatment Devices in Southern California**
  American Mosquito Control Association Annual Conference, Dallas, Texas
  Vicki Kramer
- **Mosquito Surveillance in California**
  West Nile Virus National Planning Meeting, Charlotte, North Carolina: *Vicki Kramer*
- **Rodent-borne Diseases**
  Biology Club Alumni Lectures, Whittier College, Whittier: *Curtis Fritz*
- **Tick-borne Disease Prevention and Control**
  DHS/MVCAC Tick-borne Diseases Workshop, Santa Fe Springs and Vacaville
  Renjie Hu
- **Tick-borne Relapsing Fever, Rocky Mountain Spotted Fever, and Colorado Tick Fever**
  DHS/MVCAC Tick-borne Diseases Workshop, Santa Fe Springs and Vacaville
  Lawrence Bronson
- **The Proper Use of Aerosols in Cold Fogging**
  MVCAC South San Joaquin Valley Continuing Education, Visalia: *Ken Townzen*
- **VBDS Overview and Annual Activity Summary**
  Madera County Environmental Health, Madera: *Mark Novak*

MARCH

- **Diseases and Public Health**
  Pesticide Applicators Professional Association (PAPA) Vertebrate Pest Control Workshop, San Jose: *Curtis Fritz*
- **Hantavirus Pulmonary Syndrome**
  Epidemiology & Control of Infectious Diseases (PH 253B), School of Public Health, University of California, Berkeley: *Curtis Fritz*
- **Identification of Rodents Important in Vector-borne Disease Surveillance**
  VBDS Rodent Identification Workshop, Sacramento: *Charles Smith*
- **Insecticide Resistance 101**
  VBDS Insecticide Resistance Workshop, Sacramento: *Mark Novak*
- **Lyme Disease in California**
  Oak Conversation Work Group, University of California Extension, Richmond
  Lucia Hui
- **Rodent and Lagomorph Identification**
  VBDS Rodent Identification Workshop, Sacramento: *Jim Tucker*
- **Rodent and Lagomorph Identification**
  VBDS Rodent Identification Workshop, Sacramento: *Richard Davis*
- **The Black Death: A Danse Macabre with Plague Through the Ages**
  Epidemiology & Control of Infectious Diseases (PH 253B), School of Public Health, University of California, Berkeley: *Curtis Fritz*
- **Introduction and Summary of Insecticide Resistance in Mosquitoes**
  VBDS Insecticide Resistance Workshop, Sacramento: *Ken Townzen*

- **Tick-borne Diseases in California**
  Carnegie State Park, Off Road Vehicle Area Staff Meeting: *Mark Novak*
- **Vector-borne Diseases in California**
  Amador County Health Department; Sacramento County Department of Health and Human Services; Sutter County Human Services; Yuba County Health Department; Yolo County Health Department: *Jim Tucker*
- **Wildlife and Rodent-Borne Diseases**
  Pesticide Applicators Professional Association Vertebrate Pest Control Workshop Visalia: *Richard Davis*

APRIL

- **Rodent-borne Diseases in California**
  California Environmental Health Association Annual Meeting, Sacramento: *Mark Novak*
- **Tick-borne Diseases and Hantavirus in California**
  Caltrans Regional Safety Workshop, Petaluma: *Marty Castro*
- **Tick-borne Diseases in California**
  California Environmental Health Association Conference, Sacramento: *Jim Tucker*
- **ULV Applications of Pesticides**
  Adulticide Workshop, Northwest Mosquito and Vector Control District, Corona *Ken Townzen*
- **Vector-borne Diseases in California**
  Nevada County Human Services Agency, Nevada City: *Jim Tucker*
- **Vector-borne Disease Risks for U.S. Forest Service Volunteers**
  USFS Del Rosa Fire Station, San Bernardino: *Alec Gerry*
- **Presentation and Display of Vector-borne Disease Section's Activities**
  Richmond Laboratory Open House, Richmond: *Ken Townzen*

MAY

- **California Program for Head Lice Prevention and Control**
  Colusa County Public Health and School Nurses Continuing Education Workshop Colusa: *Stan Husted*
- **Lyme Disease in California, Protection and Prevention**
  Pacific Bell Telephone Company Safety Offices, San Francisco: *Lucia Hui*
- **Performance of Topical Insecticides for Control of Plague Vector Fleas on Rodents**
  The 6th International Symposium on Ectoparasites of Pets, Westport, Co. Mayo, Ireland *Marco Metzger*
- **The Role of Silk in the Maintenance of Adult Cat Flea Quiescence Inside the Cocoon**
  The 6th International Symposium on Ectoparasites of Pets, Westport, Co. Mayo, Ireland *Marco Metzger*
- **Storm Water Treatment Devices as Potential Breeding Grounds for Disease Carriers**
  Caltrans Storm Water Quality Workshop: Storm Water Treatment Technologies, Ontario *Marco Metzger*
- **Tales of an Itinerant Epidemiologist: Or, How I Puked in the Pacific for Public Health**
  Veterinary Epidemiology (VMD 409), School of Veterinary Medicine, University of California, Davis: *Curtis Fritz*

- **Tick-borne Diseases and Hantavirus in California**
  Sonoma County Regional Parks, Pesticide Applicators Seminar, Santa Rosa
  Marty Castro
- **Tick-borne Diseases in California**
  Placer County Public Health Laboratory Certification Training: *Jim Tucker*
- **Ticks and Tick-Borne Diseases**
  U.S. Forest Service, Santa Maria: *Richard Davis*
- **Ticks and Tick-Borne Diseases of the Central Coast**
  Animal Science Zoonosis class, California Polytechnic State University, San Luis Obispo *Richard Davis*
- **Vector-borne Disease Risk at Campsites and Public Use Areas**
  California Land Management, Annual Meeting, Lake Isabella: *Alec Gerry*
- **Vector-borne Diseases and Their Prevention**
  Mariposa County Extension Pest Control Operators Continuing Education Workshop Mariposa: *Mark Novak*
- **Vector-borne Diseases in California, A Review**
  Navy Environmental Health Center Annual Conference, San Diego: *Mark Novak*

JUNE

- **Bubonic Plague and Other Health Issues in Forest Recreational Areas**
  Forest Insect and Pathogen Meeting, Laguna Mountains Campground, Cleveland National Forest, San Diego County: *Todd Walker*
- **USFS and CDHS/VBDS Cost-Shared Agreement on Vector-borne Disease Surveillance in National Forests in California**
  Inyo National Forest Concessionaires Meeting, Bishop: *Renjie Hu*
- **Vector-borne Diseases in National Forests**
  Forest Insect and Pathogen Field Meeting, Laguna Mountains, San Diego: *Renjie Hu*

JULY

- **Baylisascaris Larval Migrans in California**
  American Veterinary Medical Association 138th Annual Convention, Boston, Massachusetts: *Curtis Fritz*
- **Bubonic Plague and Other Health Issues in Forest Recreational Areas**
  Temescal Fire Station, Cleveland National Forest, Riverside County: *Todd Walker*
- **Lyme Disease and Tick Bite Prevention**
  Cleveland National Forest, Temescal Fire Station Management Meeting: *Renjie Hu*
- **A Patient's Perspective of Lyme Disease in California**
  Mid-Peninsula Lyme Disease Support Group, Mountain View: *Lucia Hui*
- **Tick-Borne Diseases in California**
  Placer County Public Health Laboratory Certification Training: *Jim Tucker*
- **Vector-borne Diseases and Avoidance**
  Back Country Horsemen of the Los Padres National Forest, Nipomo: *Richard Davis*
- **Vectors and BMPs**
  California Regional Water Quality Control Board, Santa Ana Region, Regional Board Meeting, Corona: *Marco Metzger*

AUGUST

- **Introduction of Aedes albopictus into California in 2001**
  Coastal Region Quarantine Officers (California County Agriculture Commissioners' representatives) meeting, Concord: *Stan Husted*
- **Plague, Carnivores, and Specimen Collection**
  USDA, Wildlife Services Regional Meeting, Paso Robles: *Richard Davis*
- **Vector-Borne Diseases Update**
  PAPA Seminar, Petaluma: *Marty Castro*

SEPTEMBER

- **Lyme Disease and Other Tick-borne Diseases in California**
  Lyme Disease Support Group, Chico: *Lucia Hui*
- **Those Icky Ticks: Review of Tick-Transmitted Infectious Diseases in California**
  Biology Colloquim, California State University, Sonoma: *Curtis Fritz*
- **Update on Vector-borne Diseases in California**
  PAPA Seminar, Stockton: *Mark Novak*
- **Vector–Borne Disease Update in California**
  46th Annual Conference of the California Directors of Environmental Health, Yosemite *Kenneth Linthicum*

OCTOBER

- **Aedes albopictus in California – An Update**
  MVCAC Northern San Joaquin Valley Region Continuing Education Program, Modesto *Mark Novak*
- **The Asian Tiger Mosquito – Aedes albopictus**
  MVCAC Continuing Education Training Course, Visalia: *Kenneth Linthicum*
- **Bioterrorism Threat and Anthrax**
  San Ramon Valley High School, Danville: *Lucia Hui*
- **Surveillance for Mosquito-Borne Encephalitis Virus Activity and Human Disease in California, Including West Nile, 2001**
  MVCAC Continuing Education Training Course, Visalia: *Kenneth Linthicum*
- **Tick-borne Disease Surveillance: Concepts and Sampling Methods**
  MVCAC Continuing Education Training Course, San Ramon: *Renjie Hu*
- **Ticks and Tick-borne Diseases in California**
  Northern Californian Environmental Health Directors, Lake Tahoe: *Anne Kjemtrup*
- **Update on Vector-borne Diseases in California**
  PAPA Seminar, Redding: *Lawrence Bronson*
- **Vector-borne Diseases and the Bioterrorism Threat**
  Coastal Region MVCAC Continuing Education Workshop, San Ramon: *Mark Novak*
- **Vector-borne Diseases and the Bioterrorism Threat**
  Sac-Yolo MVCD Continuing Education Program, Elk Grove: *Mark Novak*
- **Vector-borne Diseases in California**
  United States Forest Service Placerville Tree Nursery, Placerville: *Jim Tucker*
- **West Nile Virus – California or Bust?**
  Audubon Society, San Joaquin Chapter Meeting, Stockton: *Mark Novak*

NOVEMBER

- **Aedes albopictus in California – Biology and Behavior**
  MVCAC Continuing Education Training Course, Diamond Bar: *Kenneth Linthicum*
- **The Asian Tiger Mosquito in California**
  MVCAC Sacramento Valley Region Continuing Education Workshop, Willows
  Vicki Kramer
- **Nuisance Flies: Vector Control in Confined Animal Facilities**
  California Environmental Health Association, Annual Conference, Yosemite: *Alec Gerry*
- **Powers and Responsibilities of the Board**
  Colusa Mosquito Abatement District Board of Trustees, Colusa: *Ken Townzen*
- **State of California Arbovirus Surveillance System**
  MVCAC Continuing Education Training Course, Diamond Bar: *Kenneth Linthicum*
- **Urban Rodents and Control**
  PAPA Workshop, Santa Maria: *Richard Davis*
- **West Nile Virus in the United States and the California Arbovirus Surveillance Program**
  MVCAC Sacramento Valley Region Continuing Education Workshop, Willows
  Stan Husted

DECEMBER

- **The Downside of Stormwater Runoff Management: Disease Vectors & Structural BMPs in Southern California**
  Caltrans Storm Water Quality Workshop: Storm Water Treatment Technologies, Ontario
  Marco Metzger
- **Evaluation of Vectorial Capacity as a Predictor of Bluetongue Transmission to Cattle in Southern California**
  Annual Meeting of the Entomological Society of America, San Diego: *Alec Gerry*
- **Everything You Have Always Wanted to Know About Fleas, But Were Afraid to Ask**
  MVCAC Coastal Region Continuing Education Workshop, San Ramon: *Al Hom*
- **Mapping Potential Risk of Rift Valley fever Epizootics/Epidemics in African Savannas using Satellite Time Series Data**
  Annual Meeting of the Entomological Society of America, San Diego
  Kenneth Linthicum
- **Mosquitoes and Public Health in California**
  Caltrans Storm Water Treatment Technologies Workshop, Ontario: *Vicki Kramer*
- **Tick-borne Ehrlichiosis in California**
  Annual Meeting of the Entomological Society of America, San Diego: *Curtis Fritz*
- **Use of an Orally Administered Chitin Inhibitor (Lufenuron) to Control Flea Vectors of Plague in California**
  Annual Meeting of the Entomological Society of America, San Diego: *Richard Davis*

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